



## Deliverable D2.5

A set of serious games for massive societal impact: design and features



This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101075582



Project funded by

Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra  
Swiss Confederation

Federal Department of Economic Affairs,  
Education and Research EAER  
State Secretariat for Education,  
Research and Innovation SERI

**Document information Table**

Project Data			
Project acronym	RES4CITY		
Project title	Renewable Energies System for Cities		
Grant agreement n.	101075582		
Topic identifier	HORIZON-CL5-2021-D3-02-02		
Funding scheme	HORIZON-CSA		
Project duration	36 months		
Coordinator	Maynooth University (NUIM)		
Website	www.res4city.eu		
Deliverable Document Sheet			
Deliverable no.	D2.5		
Deliverable title	A set of serious games for massive societal impact: design and features		
Description	Description of the design, features and structure of the Serious Game Suite in its three tools: Warm Up Game, Business Simulation Game and Role Paly Game. Description of the design, development and implementation of the “Fabian Community Game” for the Sustainable Energy Week.		
WP No.	2		
Related tasks	T2.1, T2.2, T2.5		
Lead beneficiary	ARTEMAT		
Author(s)	Tommaso Terenzio		
Contributor(s)	Angelo Mendicelli, Maica Giulia Apa		
Reviewers	David McLoughlin		
Type	Report		
Dissemination L.	Public		
Due date	30-11-2023	Submission date	30-11-2023

Version	Date	Author(s)	Organisation	Comments
0.1	03-11-2023	Tommaso Terenzio, Angelo Mendicelli, Maica Giulia Apa	ARTEMAT	
0.2	28-11-2023	Tommaso Terenzio, Angelo Mendicelli, Maica Giulia Apa	ARTEMAT	
1.0	29-11-2023	Tommaso Terenzio, Angelo Mendicelli, Maica Giulia Apa	ARTEMAT	

## DISCLAIMER

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

This document and all information contained here is in the sole property of the RES4CITY Consortium. It may contain information subject to Intellectual Property Rights. No Intellectual Property Rights are granted by the delivery of this document or the disclosure of its content. Reproduction or circulation of this document to any third party is prohibited without the written consent of the author(s).

The dissemination and confidentiality rules as defined in the Consortium agreement apply to this document. All rights reserved.



## Table of contents

Document information Table .....	2
DISCLAIMER .....	4
Table of contents .....	5
List of Figures .....	6
List of Acronyms.....	8
Executive Summary .....	9
1. Introduction .....	10
2. Overview of Gamification and Serious Games .....	11
2.1 The meaning of Gamification .....	11
2.2 Serious games for educational and corporate activities .....	12
3. Suite of RES4CITY Serious Games .....	13
3.1 Warm Up Game .....	14
3.1.1 Technology and structure .....	14
3.1.2 Training Modules .....	17
3.1.3 Report .....	20
3.2 Business Simulation Game.....	20
3.2.1 Technology.....	20
3.2.2 Simulation Scenario Overview: “RES4CITY Business Simulation Game” .....	22
3.2.3 RES4CITY Business Simulation Game: Round 1 – Analysis phase.....	23
3.2.4 RES4CITY Business Simulation Game: Round 2 and 3 – Gaming phase .....	26
3.2.5 Strategic Choices.....	27
3.2.6 Energy consumption and carbon footprint .....	36
3.2.7 Performances and Competitiveness.....	36
3.2.8 Economic Reports .....	39
3.2.9 Intellectual capital .....	42
3.2.10 Market Success .....	43
3.2.11 How to play.....	44
3.2.12 Game Glossary (technical terms).....	51
3.2.13 Hard and Soft Skills .....	54
3.3 Role Play Game .....	55
3.3.1 Technology.....	55
3.3.2 Simulation structure .....	57

3.3.3 Simulation scenario design .....60

3.3.4 Simulation Scenario Overview: “Fabian Energy Community Game” .....62

3.3.5 Features of “Fabian Energy Community Game” .....62

3.3.6 Hard and Soft Skills .....64

3.3.7 Simulation Storyboard .....64

3.3.8 Report .....72

3.3.9 User feedback .....74

**List of Figures**

Figure 1. Serious Game Suite .....9

Figure 2. Examples of hard and soft skills.....11

Figure 3. Warm Up Game Interface/1 .....16

Figure 4. Warm Up Game Interface/2 .....17

Figure 5. Example of exercise .....18

Figure 6. Example of exercise .....18

Figure 7. Example of exercise .....19

Figure 8. Example of exercise .....19

Figure 9. Example of exercise .....20

Figure 10. Business Game Studio Platform .....21

Figure 11. Business Simulation Game interface – Multidevice .....22

Figure 12. Screenshot - Industry fact sheet.....23

Figure 13. Screenshot – “EcoDelight” fact sheet.....24

Figure 14. Screenshot – “EarthGrain” fact sheet.....24

Figure 15. Screenshot – “TwirlTaste” fact sheet .....25

Figure 16. Screenshot – “GreenGourmet” fact sheet .....25

Figure 17. Screenshot – Firms profile .....26

Figure 18. Screenshot – Functional areas.....26

Figure 19. Screenshot – Human Resources Area.....27

Figure 20. Screenshot – “Ms Martha” profile.....28

Figure 21. Screenshot – “Ms Irene” profile .....28

Figure 22. Screenshot – “Ms Ellie” profile .....29

Figure 23. Screenshot – “Mr Thomas” profile .....29

Figure 24. Screenshot – Marketing Area .....31

Figure 25. Screenshot – Innovation and Sustainability Area.....32

Figure 26. Screenshot – “BigK Co.” profile .....33

Figure 27. Screenshot – “Alchemy” profile.....33

Figure 28. Screenshots – Energy consumption and carbon footprint.....36

Figure 29. Screenshots – Energy consumption and carbon footprint performance.....37

Figure 30. Screenshots – Quality, Customer Satisfaction, Sustainability and Price performance .....38

Figure 31. Screenshot – Competitiveness .....38

Figure 32. Screenshot – EBITDA.....40

Figure 33. Screenshot – Cash.....40

Figure 34. Screenshot – Free Cash Flow To The Firm .....41

Figure 35. Screenshot – Intellectual Capital Performance .....	42
Figure 36. Screenshot – Market Value .....	43
Figure 37. Screenshot – Login web page .....	44
Figure 38. Screenshot – Web interface: round 1.....	44
Figure 39. Screenshot – Web interface: round 2 and 3.....	45
Figure 40. Screenshot – Report .....	45
Figure 41. Screenshot – Firms profile: Choose the firm profile .....	46
Figure 42. Screenshot – Marketing area: strategic choices.....	46
Figure 43. Screenshot – “histogram” and “hand lens” button.....	46
Figure 44. Screenshot – All input variables .....	47
Figure 45. Screenshot – “Results” section .....	47
Figure 46. Screenshot – How to navigate the web interface/1.....	48
Figure 47. Screenshot – “Market Value” trend .....	48
Figure 48. Screenshot – How to navigate the web interface/2.....	49
Figure 49. Screenshot – Economic Reports .....	49
Figure 50. Screenshot – Production.....	50
Figure 51. Web InBasket platform .....	56
Figure 52. Simulation Automata Scheme .....	57
Figure 53. Chapters scheme .....	58
Figure 54. Event graph scheme .....	59
Figure 55. Screenshot - Login page.....	62
Figure 56. Screenshot - Introduction .....	63
Figure 57. Screenshot - "Choose your avatar" .....	63
Figure 58. Screenshot - other characters .....	64
Figure 59. Screenshot - starting event (chat tool).....	65
Figure 60. Screenshot - starting event (answer) .....	65
Figure 61. Screenshot - answer selected and subsequent chat .....	66
Figure 62. Screenshot - Test (question and answers) .....	66
Figure 63. Screenshot - "carbon emission" (chat) .....	67
Figure 64. Screenshot – Energy audit report/1 .....	68
Figure 65. Screenshot – Energy audit report/2 .....	68
Figure 66. Screenshot - Energy plan/1.....	69
Figure 67. Screenshot - Energy plan/2.....	69
Figure 68. Screenshot - Energy plan/3.....	70
Figure 69. Screenshot – Meeting/1 .....	71
Figure 70. Screenshot – Meeting/2 .....	71
Figure 71. Screenshot – Meeting/3 .....	71
Figure 72. Screenshot – Final event.....	72
Figure 73. Screenshot - Report .....	73
Figure 74. Report .....	74
Figure 75. Screenshot - Feedback form .....	75

## List of Acronyms

Acronym	Meaning
RES4CITY	Renewable Energies Systems for Cities
WUG	Warm Up Game
BSG	Business Simulation Game
RES4CITY BSG	RES4CITY Business Simulation Game
BGS	Business Game Studio
RPG	Role Playing Game
FECG	Fabian Energy Community Game

## Executive Summary

This report describes the design, development and implementation of a serious game suite focused on sustainability, renewable energy sources and fuel technologies. Serious games are innovative and engaging tools designed with specific learning objectives or goals. They aim to impart knowledge, develop skills, or change behaviours in players. They have become increasingly popular in education as well as for corporate training, recruitment, assessment and employer branding. In particular, three specific and different tools compose the suite:

- **Warm Up Game (WUG):** this is a single player tool that trains users on specific topics. The game is composed of different training modules and for each module users learn the key concepts, developing and boosting their technical skills. Each module is composed of a set of exercises: per each exercise the user can review multimedia materials (pdf, video, audio, picture, clip, etc.) before choosing the answer or completing it. It is possible to assign a score and a skill to each answer. The platform generates a report/profile at the end of each module (the simulation is composed of four modules), showing a final score, skills mapping and suggestions.
- **Business Simulation Game (BSG):** this is an innovative and engaging educational and training tool that allows users to replicate the dynamics and logics of a specific business scenario. Users, individually or in team, face a competitive situation in order to stimulate the application of their problem solving, creativity, strategic analysis and decision-making skills. The task is to lead a virtual company analysing data and making strategic decisions within the game, which have consequences on the outcome. These decisions involve areas such as marketing, finance, operations, sustainability and human resources.
- **Role Playing Game (RPG):** this is a single-player tool designed as an interactive experience, incorporating and combining training constructs and digital elements, which operate together in a virtual environment. On the basis of the simulation storyboard, the user can face different complex situations (events) and make a real-time decision by choosing among alternatives pushed by the platform via email, chat and meetings. The user must organize work, assign priorities, delegate, manage information and solve critical issues, collecting scores. At the end of the simulation, after the last event pushed by the system, the platform automatically generates a report (detailed profile).

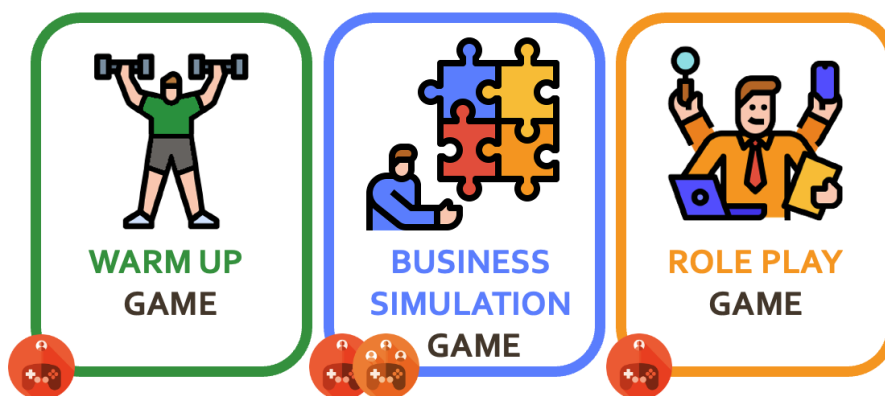


Figure 1. Serious Game Suite

## 1. Introduction

Serious games leverage gamification principles and immersive experiences to face complex social, environmental and economic challenges. In other words, they have the potential to create massive societal impact by combining the game design elements with educational and meaningful content. In fact, these games are transforming traditional learning methods by offering a dynamic, engaging and user-friendly platform. In the realm of sustainability, renewable energy, and fuel technologies, serious games are proving to be powerful tools for raising awareness and fostering a deep understanding of these topics.

When designing serious games for societal impact, several key features and considerations can enhance their effectiveness and reach:

- **Educational content and learning objectives:** games should integrate educational content and learning objectives. They can include resources, data and reports that help players understand the context and importance of the proposed issues.
- **Engaging storyboard:** a compelling and immersive storytelling keeps players invested in the experience, increasing their motivation to continue playing.
- **Relevant and real challenges:** games should address real-world challenges, such as sustainability, energy saving, education, etc. Players should encounter scenarios and decision-making situations that mirror the complexities of the actual issues.
- **Feedback mechanism and evaluation:** players should be provided with immediate feedback on their actions and decisions, helping them understand the potential impact of their choices. Evaluation and assessment mechanisms should be offered to help players understand their performance, reinforcing learning and improvement.
- **Inclusivity and diversity:** games should be designed to be inclusive and representative of diverse communities and perspectives. By creating relatable characters and scenarios, the games can foster empathy and understanding.
- **Awareness and behavior change:** thanks to their immersive and interactive nature, games have the power to raise awareness on critical issues like never before and encourage behavior change.

The serious game suite has been designed and developed on the basis of all the previous considerations and, mainly, on the basis of the outcomes of the Task 2.1 (T2.1: Innovative sustainable strategies for carbon neutral smart cities) and Task 2.2 (T2.2: Lighthouse case studies development). The main objective is to provide gamification tools for an innovative and involving learning experience. At the same time, players can become better informed, inspired, and empowered to make choices that promote sustainability in its different aspects (economic, social and environmental).

## 2. Overview of Gamification and Serious Games

### 2.1 The meaning of Gamification

*“Gamification is the use of game design elements in non-game contexts<sup>1</sup>”.*

Gamification is a dynamic and innovative concept that has garnered significant attention across different fields, from education and training to recruitment, assessment, employer branding and beyond. The application of gamification tools increases users attraction towards specific topics and, at the same time, engages players in creative and innovative ways. Users are able to “build” a bridge between theory and practice, increasing the learning effectiveness. In fact, these interactive digital experiences offer a compelling fusion of entertainment and learning, making complex concepts more accessible and engaging for students, professionals and employees that, at the same time, can develop, boost and test their technical and soft skills.

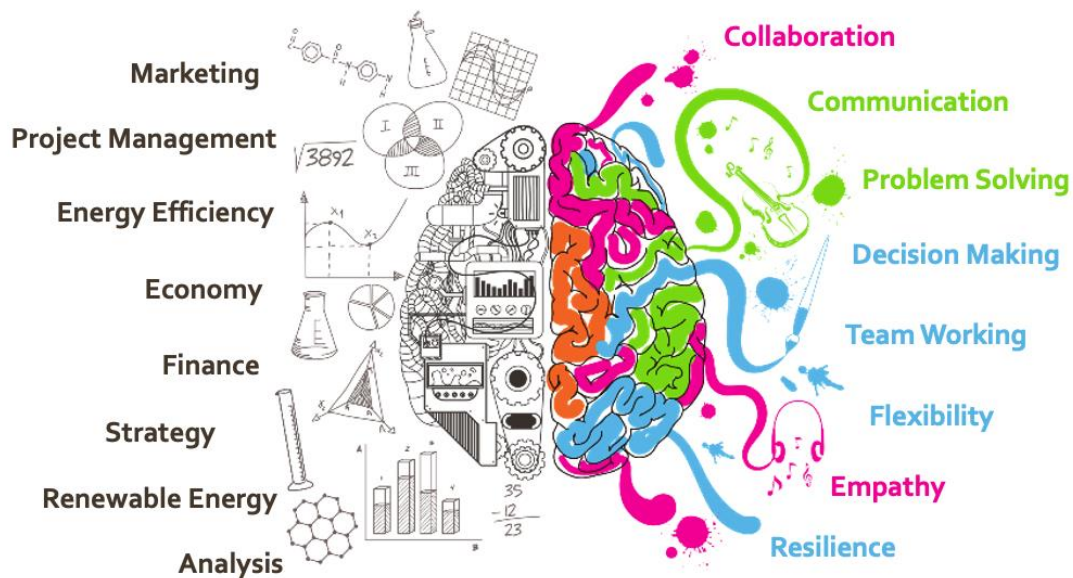


Figure 2. Examples of hard and soft skills

The main game design elements used to develop a gamification tool are the following:

1. **Rules of the game:** these are the basis of every gamification tool, providing the perimeters for the actions of the players. The rules establish a level “playing field”, ensuring fairness and equity. In addition, the rules make the game more consistent and understandable.
2. **Objectives:** achieving objectives in a gamification tool is essential to ensure a high level of engagement. Players are typically required to achieve specific objectives that are aligned with the game's educational or training goals. These objectives serve as markers of progress and

<sup>1</sup> S. Deterding, D. Dixon, R. Khaled, L. E. Nacke, 2011. *Gamification: Toward a Definition*, Canada. ACM 978-1-4503-0268-5/11/05.

success within the game, and they are designed to facilitate learning, skill development, or behavior change.

3. **Competitiveness:** fostering positive competitiveness in a serious game can enhance the learning experience and motivation of the players. Positive competitiveness encourages healthy competition, collaboration, and engagement among participants while maintaining a supportive and constructive environment.

The integration of the rules, objectives and positive competitiveness ensures an effective gamification tool for training, recruitment or employer branding activity.

## 2.2 Serious games for educational and corporate activities

Serious games belong to the big family of Gamification tools. They have immersive narratives, scenarios, or simulations that help learners acquire specific knowledge, skills, or attitudes. For the previous reasons, serious games are used extensively in both the educational and corporate sectors due to their effectiveness in engaging learners, promoting skills development, and achieving different educational and training goals. From an educational point of view, the application of serious games achieves the following **benefits**:

- **Unconventional and innovative educational activities:** by combining elements of play, interactivity, and educational content, serious games offer an unconventional and innovative approach to education that can captivate students' interest and enhance their learning experiences.
- **Learning by doing and learning by playing:** serious games promote "learning by doing" and "learning by playing" approaches, which are highly effective educational methods that emphasize active engagement and practical experience.
- **The learning experience is more effective and involving than traditional teaching alone:** when used in educational settings, serious games offer a unique and engaging approach to learning, that may be integrated with traditional methods.
- **To face the changing scenarios and develop flexibility:** serious games simulate realistic scenarios, including dynamic and changing environments. By engaging with these scenarios, individuals can develop adaptability and learn to respond effectively to new and unexpected situations.
- **To learn different and complex concepts in an easy and involving way:** serious games create a dynamic and effective learning environment that simplifies complex concepts and promotes a deep understanding of the subject matter. This approach is particularly valuable in educational contexts where complex topics need to be conveyed in an engaging and accessible manner.
- **To stimulate, boost and develop technical and soft skills:** these games offer an engaging learning environment that encourage the acquisition and refinement of a wide range of skills. Serious games can cover a wide range of technical subjects, exposing learners to different areas of expertise and encouraging interdisciplinary learning. At the same time, they can stimulate problem solving and decision-making skills and many more.

On the other hand, from a corporate point of view, the application of serious games achieves the following benefits:



- **Unconventional and innovative corporate activities:** incorporating serious games into corporate activities can create a more interactive, creative, and engaging training and recruitment process. It benefits both employers and candidates by improving skills development and assessment, and promoting a positive employer brand.
- **To assess the technical and soft skills of the candidates:** serious games can be used for performance assessments, allowing organizations to evaluate candidates' skills, knowledge, and competencies in a gamified environment.
- **To stimulate, boost and develop the technical and soft skills of the employees:** by incorporating serious games into corporate activities, organizations can make learning and development more engaging, foster innovation and creativity, and address specific organizational needs while providing employees with an enjoyable experience.
- **Team working and team building:** serious games encourage teamwork and collaboration, fostering interpersonal skills and the ability to work effectively in groups.
- **To make the talent acquisition process more engaging and increase the candidate experience:** companies who incorporate serious games into the hiring process can enhance the employer brand, attracting top talent who value creativity and forward-thinking.

### 3. Suite of RES4CITY Serious Games

The RES4CITY serious game suite has been designed and developed in order to be used both in educational and corporate contexts, promoting sustainability and providing innovative and engaging tools to develop and boost technical and soft skills of students, professionals and employees. Serious games include all the fundamental topics of the RES4CITY project (renewable energy systems, fuel technologies, green transition, circularity, etc.), and are useful to simulate specific scenarios and to allow users to play in a realistic simulated environment where they have to make decisions and take specific actions: the main objective is to promote the attitude towards sustainability in all its dimensions.

Three specific and different tools compose the suite:

- **Warm Up Game (WUG):** a single player tool that trains users on specific topics.
- **Business Simulation Game (BSG):** it is an innovative and engaging educational and training tool that allows users to replicate the dynamics and logics of a specific business scenario.
- **Role Playing Game (RPG):** a single-player tool designed as an interactive experience, incorporating and combining training constructs and digital elements, which operate together in a virtual environment.

### 3.1 Warm Up Game

Warm Up Game (WUG) is a single player tool that trains users on specific topics. The game is composed of four different training modules: Design and Analysis, Social Science, Energy Economics, and Energy Policy. The WUG platform, as a simulation-based learning tool, offers several key benefits for users:

- **Increased engagement:** The platform fosters active engagement and encourages the user to be more involved in the learning process. This engagement leads to better retention and understanding of the material.
- **Problem solving:** Users are presented with complex problems and case studies. This challenges them to analyze, think critically, and come up with solutions. Problem-solving is a valuable skill that is honed through this process.
- **Skills development:** Users can learn the key concepts per each module of the game, developing and boosting their technical skills.
- **Feedback and reflection:** The inclusion of a final report in the simulation serves as a tool for feedback and reflection. Users can assess their performance, identify areas for improvement, and make adjustments. This feedback loop supports continuous learning and self-improvement.
- **Versatile and convenient web platform:** The web-based platform offers accessibility and convenience. Users can access and participate in the simulations from various devices with internet connectivity. This flexibility makes learning more accessible and user-friendly.
- **Motivation:** Users are more likely to be engaged and enthusiastic about the learning process, which can lead to better outcomes and a deeper understanding of the material.

Overall, the WUG platform provides an effective and engaging educational tool that promotes active learning, skills development, and critical thinking. It is a valuable resource for educators and learners looking to enhance the quality of education and training.

#### 3.1.1 Technology and structure

The Warm Up Game platform, as a web-based application, offers a robust and user-friendly environment. Here's a breakdown of the key features and interfaces within the platform:

**Web-Based Application:**

- The platform is accessible through web browsers, making it highly convenient for users and eliminating the need for proprietary software installation.
- Updates to the platform are easily managed, and they are automatically reflected on all devices, simplifying maintenance and ensuring all users have access to the latest features and bug fixes.

**Multi-Layer Structure:**

- The platform is designed with a multi-layer structure, consisting of the presentation layer, business layer, and persistence layer. This separation of functions into layers allows for independent development and updates, promoting scalability and maintainability.

**Interfaces:**

1. **Administrator Interface:**
  - Administrators have access to a dedicated interface that allows them to perform various operations related to simulation management and user oversight.

- Key administrator operations include:
  - Creation and configuration of new simulation with unique properties, such as ID, name, and associated users. Each simulation is composed of a number of modules.
  - Addition of a set of users to a simulation.
  - Real-time monitoring of summary reports on the status of simulations for each user, providing administrators with insights into user progress.
  - Access to detailed reports for each user upon completion of simulations, allowing administrators to view and download these reports for evaluation and feedback.
- 2. User Interface:
  - The user interface is designed for participants and is accessible through modern web browsers (e.g., Google Chrome, Mozilla Firefox).

The simulation platform:

- provides a digital environment where users can engage in educational simulations. This environment serves as the backdrop for the learning activities. Administrators can set one or more training modules, designed to address specific educational objectives or skills that need to be assessed.
- supports the setting of one or more simulations, which serve as containers for users authorized to run modules based on specific models. The simulations can have unique identifying properties, making it easy to organize and manage users and modules;
- includes different types of exercises that are designed to engage users in different ways and assess their knowledge and skills effectively.
- assesses users' answers and assigns a specific score. This system may include criteria for correctness, completeness, and quality of the answers.
- generates a comprehensive simulation report that includes logical and mathematical formulas. This report is based on the evaluations of exercises and provides an overall assessment of the user's performance. It also offers detailed feedback for each exercise, explaining why a solution is correct, partially correct, or incorrect. This feedback is invaluable for users to learn from their mistakes and improve their skills.

The Warm Up Game platform allows users to access previously completed exercises. A left-hand sidebar shows the exercises set, each exercise is identified by a button with a "title" and an "icon". At the top, a fixed header bar is displayed throughout the simulation. In the middle section of the interface, the exercise content is shown. This section is further split into three sections:

- Case Study Header: This section includes a bar with the following features.
  - Information about the total and partial progress of the module.
  - The residual time for the overall module.
  - The residual time per each exercise.
  - The number of exercises completed.
  - A collection of tools useful for solving the exercise, such as a "calculator" and a "MatPad". The "calculator" tool is a scientific calculator that allows user to perform calculations. The "MatPad" allows for the calculation of complex formulas with the use of variables.
- Right Sidebar: The right-hand sidebar contains elements that support the exercise, including attachments and suggestions, as well as keywords related to the displayed exercise.

- Middle Content: The middle section provides key information for solving the exercise, including:
  - Title.
  - Exercise Text.
  - Answer type.
  - A "Submit" button to confirm the selected choice (solution).
  - An optional text area for additional comments on the provided choice (solution).

The platform supports different exercise formats:

- Single choice.
- Multiple choice.
- Ordering Item list.
- Categorization items.
- Ordered sequences.
- Open-ended answers.

Users can view the different modules activated by the administrator. Per each module, the user can play one or more times and view the report at the end of the module.

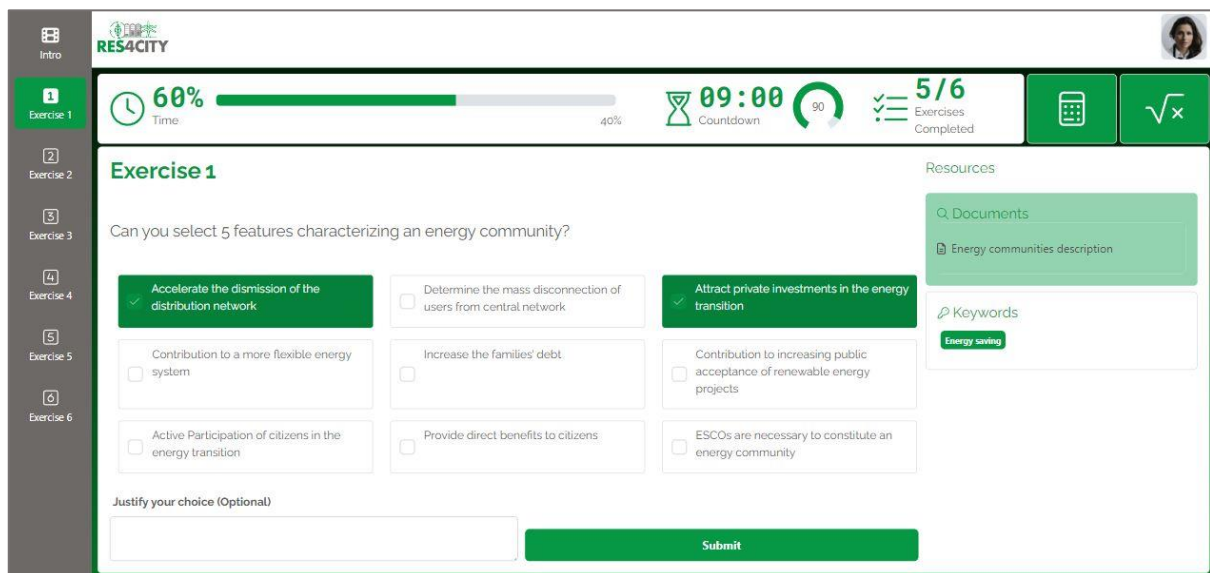


Figure 3. Warm Up Game Interface/1

The simulation model is structured as a JSON file that defines the configuration of each module and its exercises set. Per each module, it is possible to define:

- Instructions.
- Exercises set.
- Report.

Instruction Section:

- the instruction section includes a slideshow of images, text, and videos, with the aim to introduce the user to the simulation, how the platform works and learn the rules and objectives of the module.

Exercises Set:

- The core of the simulation consists of a set of exercises, each designed to assess users' knowledge and skills.
- Every typology of exercises shares a common structure, which includes the following elements:
  - An identifier ID for the exercise.
  - A title which describes it.
  - A time available in order to complete the exercise.
  - One or more keywords that characterize the topic of the exercise.
  - A text that describes the exercise and its features.
  - One or more attached documents (optional), necessary in order to provide the best possible solution.
  - An answer area, according to the type of exercise (single choice, multiple choice, ordering Item list, categorization items, ordered sequences, open-ended answers).
  - A text area (optional), useful in order to explain the reasoning behind the solution chosen.
  - One or more tips (optional). The user can choose to “require” more information about the exercise in order to simplify the choice of the solution. The request of a tip automatically generates scoring penalties.

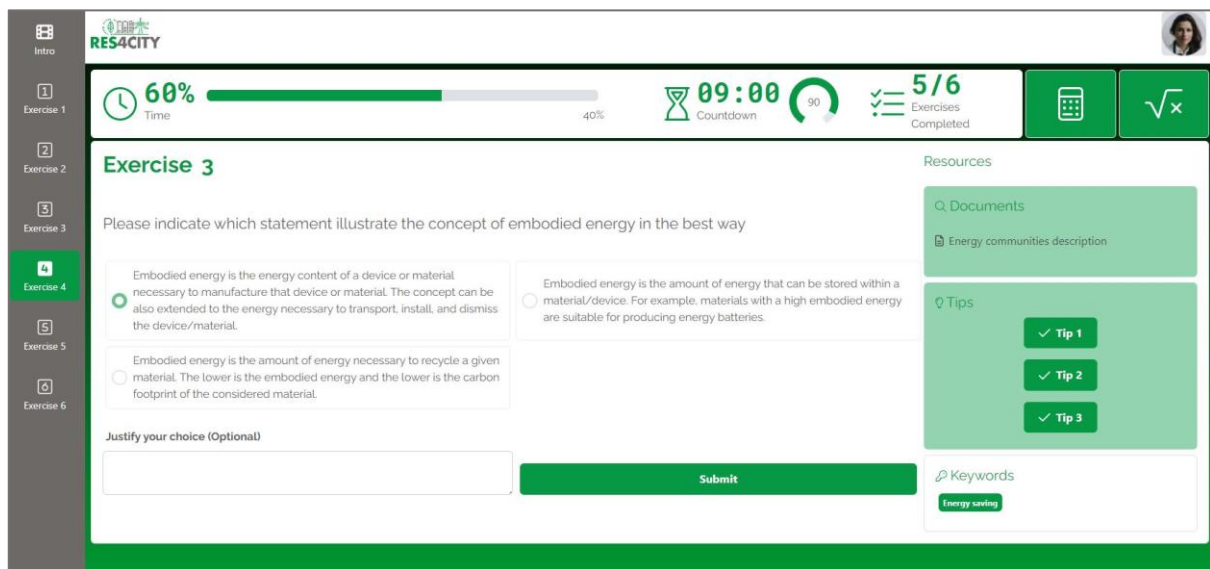


Figure 4. Warm Up Game Interface/2

### 3.1.2 Training Modules

WUG is composed of four different training modules, focused on sustainability topics: Design and Analysis, Social Science, Energy Economics and Energy Policy. Each of them is a stand-alone module composed of a set of exercises. Per each exercise the user can check multimedia materials (pdf, video, audio, picture, clip, etc.). A report is generated at the end of each module, indicating the final score, skills mapping and suggestions.

Module: **Design and Analysis**

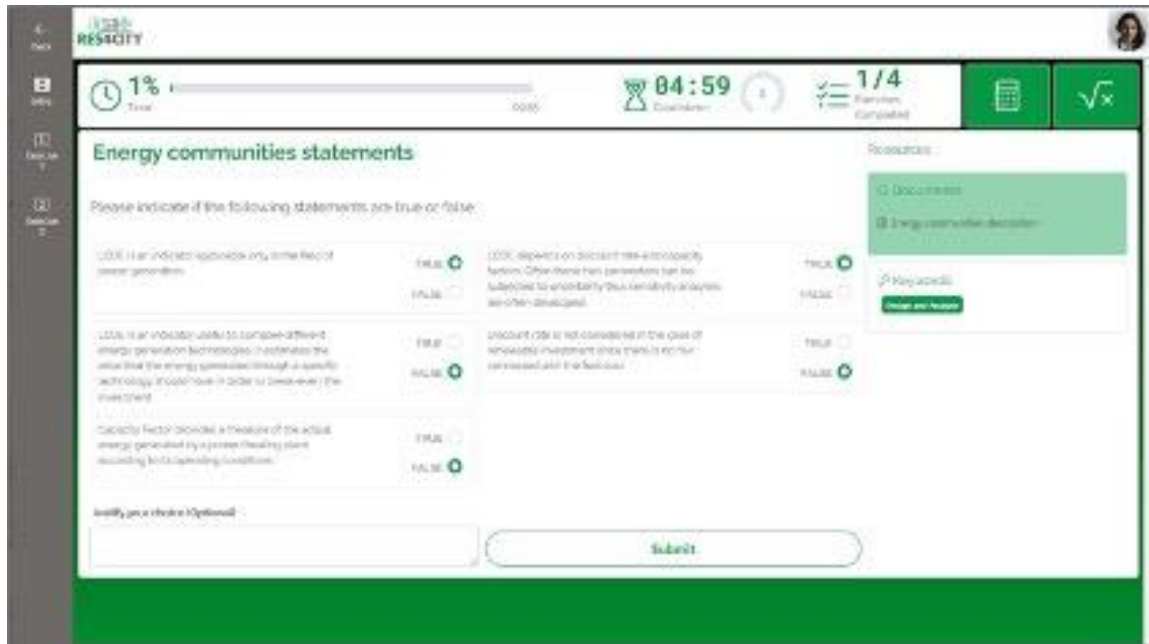


Figure 5. Example of exercise

Module: **Social Science**

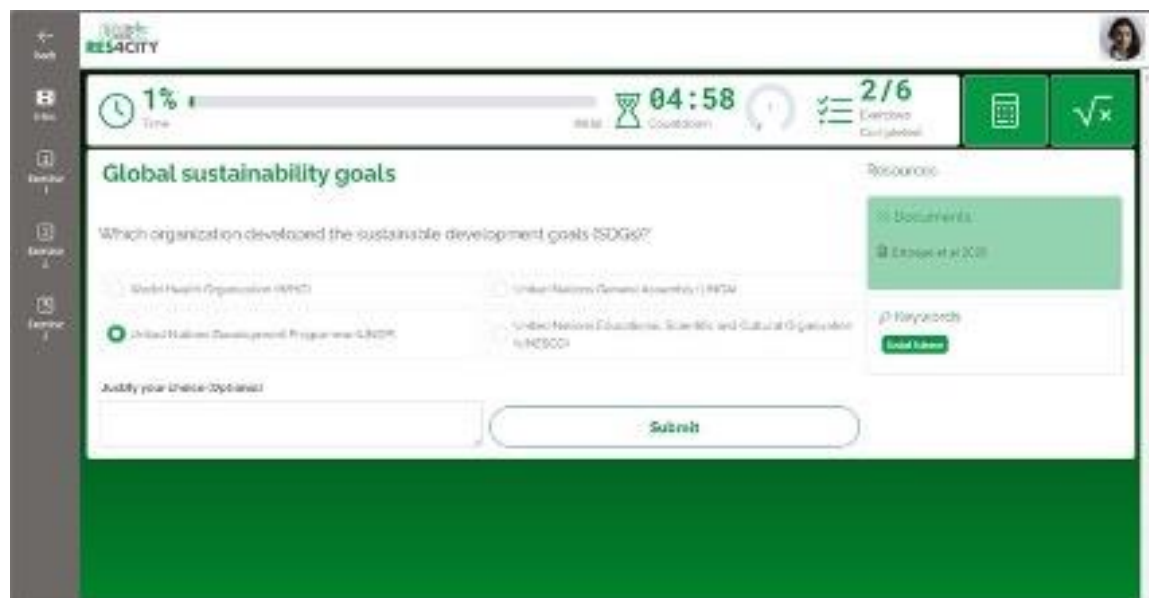


Figure 6. Example of exercise

Module: Energy Economics

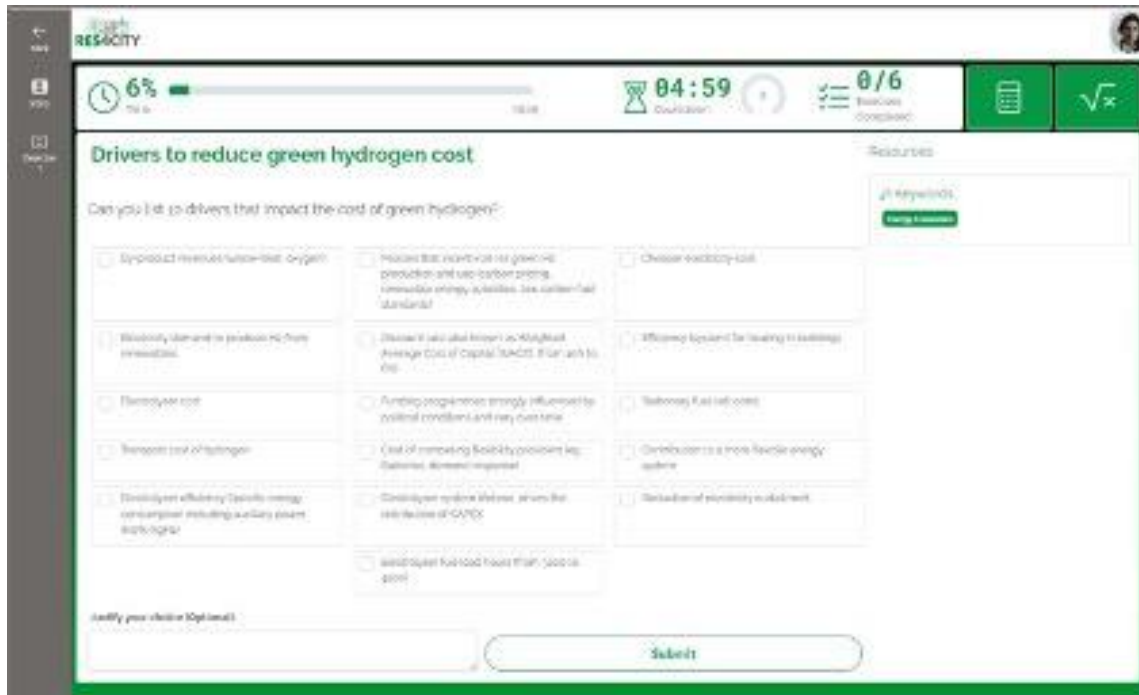


Figure 7. Example of exercise

Module: Energy Policy

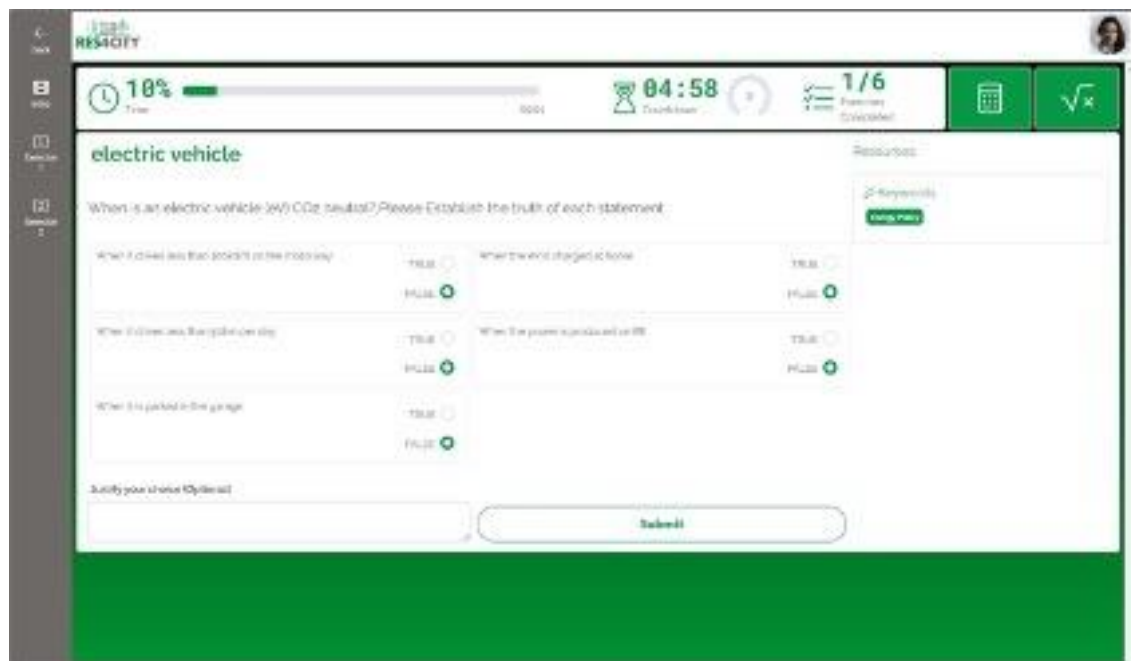


Figure 8. Example of exercise



### 3.1.3 Report

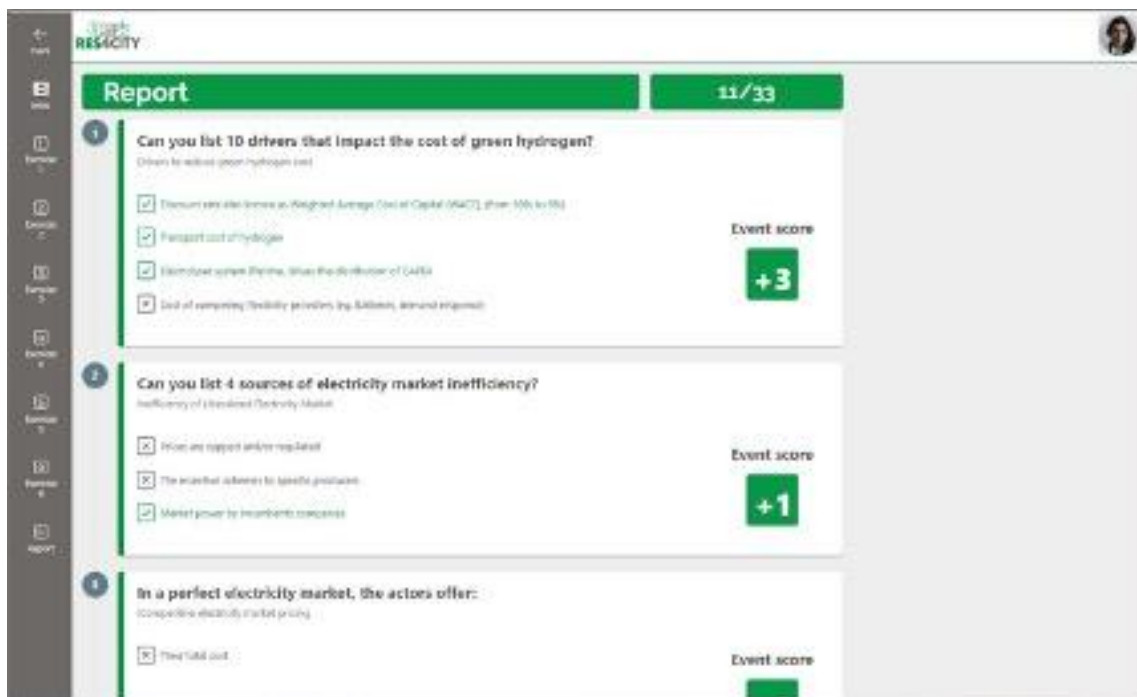


Figure 9. Example of exercise

## 3.2 Business Simulation Game

Business Simulation Game (BSG) is an innovative and engaging educational and training tool that allows users to replicate the dynamics and logics of a specific business scenario. Users, individually (single player version) or in team (multiplayer version), face a competitive situation in order to stimulate the application of their problem solving, creativity, strategic analysis and decision-making skills. The task is to lead a virtual firm analysing data and making strategic decisions within the game, which have consequences on the outcome. BSG includes different learning and training areas, fostering a comprehensive understanding of corporate strategic functions and enhancing knowledge and skill acquisition. BSG is effective in developing specific managerial competencies, including strategy development, sustainability, goal achievement, and business administration comprehension. Moreover, BSG enhances soft skills such as decision-making, problem-solving and adaptability to varying circumstances. Business Simulation Gaming activity is composed of simulation steps: at the end of each step, it is possible to analyse the achieved results.

### 3.2.1 Technology

Business Simulation Game has been developed using Artémat's proprietary web-based platform with client-server architecture Business Game Studio (BGS). The Business Game Studio platform (BGS) was developed and implemented by Artémat using Java technology. The platform is characterized by a Java class library (BGL – Business Game Library) which allows for customization of the different components of a generic business simulation game. The simulation engine is executed within a web-server to allow different types of users' access to the platform through the use of the main popular



browsers. BGS uses a specific formal language, BGLa – Business Game Language, developed by Artémat to design and implement the economic models (virtual scenario). This kind of language is used to define the game's variables and the mathematical relationships that describe the rules at the base of the simulated economic scenario.

A generic business simulation game is made up of:

- A set of **input variables** (Strategic Choices) for the different business areas in which each player has to make decisions round by round.
- A set of **logical and mathematical relationships**, calculated by the simulator and functional to the definition of the "state of the market" (as defined by: business performances, budget values, market share, sales, intellectual capital and market value of the firm) and of the results of the simulation round. In particular, the simulator converts each strategic choice (input variable) into an indicator, between 0 and 1, that represents the impact on the market. Indicators are calculated by the ratio between the values of the variables entered by a generic firm and the max value among the variables entered by its competitors. The higher the value of a variable, the higher the relative indicator (opposite logic for the evaluation of the price).
- A set of **economic reports** through which players can view and check the results achieved by the firm during the reporting round.
- A set of **parameters** used to calibrate and size the economic model for the target market.

The market is considered as a dynamic model characterized by the interaction of several factors. Firms producing a diverse range of products represent the offer; demand is defined by quasi-random algorithms or by input from the game administrators, in order to simulate the most appropriate trends according to the target market. The simulation system identifies the one who obtains the highest value of the variable "Market Value" as the winner of the competition. This variable is calculated on the basis of tangible and intangible values relative to a generic firm operating in the market.

Business Game Studio is characterized by different strengths:

- Flexibility and customization: the platform allows for a high degree of customization of the game scenarios. In fact, it is possible to configure the competitive scenario, strategic variables, the measurement system of performance indicators, the economic parameters, the number of rounds, and much more.
- In/Out Logic: the logical structure of the Business Simulation Game is composed by a set of strategic levers (Input) and by a set of logical mathematical relations (Output), calculated by the simulator. Learning is a cyclical process for users as they move through rounds of evaluation, logical decision making, and the revaluation of results as conditions change.



Figure 10. Business Game Studio Platform

- Evaluation of Intellectual Capital: Artémat tools are among the first to consider the importance of Intellectual Capital in determining the market value of a firm.
- User friendly web interface: the web interface is designed to be user-friendly, eye-catching, and equipped with tools to help with business analysis (reports, calculator, relevant data and other information).

### 3.2.2 Simulation Scenario Overview: “RES4CITY Business Simulation Game”

Based on the proprietary platform of Artémat, Business Game Studio, the new business simulation game scenario, called “RES4CITY Business Simulation Game” (RES4CITY BSG), has been designed, developed and implemented. RES4CITY BSG has been designed and developed with a specific focus on the food sector, and in particular the pasta industry. This sector is evolving towards prioritizing quality over quantity, emphasizing sustainability, environmental aspects and quality aspects of food, and leveraging innovation to meet market demands while maintaining affordability.

The user faces a competitive situation in order to stimulate, develop and boost their technical and soft skills. The task is to lead a virtual firm analysing data and making strategic decisions within the game, which have consequences on the outcome. These decisions involve areas such as human resources, marketing, innovation and sustainability.



Figure 11. Business Simulation Game interface – Multidevice

The user, playing the role of a specific professional, is asked to analyse the industry scenario and lead a virtual firm in a competitive market. RBSG is composed of three rounds, each round simulates one year of operability of the firm on the market:

- First round: the user must analyse and evaluate the industry, and the fact sheets of a number of firms – and then select one in order to lead that firm in the second and third rounds.

- Second and third rounds: the user leads the selected firm, making decisions about the main strategic choices that characterize the market. The task is the complete management of the business, with a specific focus on innovation and sustainability. The objective is to increase the company's market value over two years.

### 3.2.3 RES4CITY Business Simulation Game: Round 1 – Analysis phase

The user plays the role of Sustainability Advisor, checking and evaluating an industry scenario (“Pasta” industry) and four company profiles. The industry and each company profile are characterized by a specific and detailed “fact-sheet”.

All costs and quantities indicated below are for demonstration purposes only.

**Industry fact sheet:** user can check an overview, a section on sustainability and the main trend for the next virtual years. In particular, the overall demand (per each round), the “Energy price” and the customer sensitivity (articulated across four areas: quality, customer satisfaction, sustainability and pricing) are indicated. The potential trend of the customer sensitivity is showed over three virtual years.

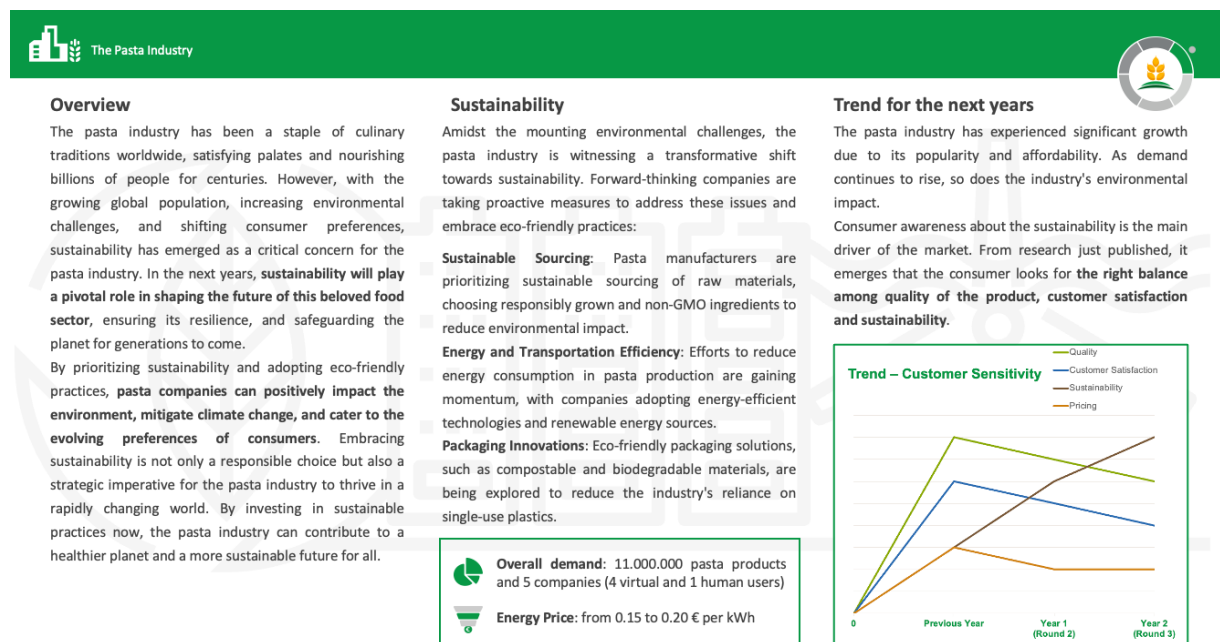


Figure 12. Screenshot - Industry fact sheet

Analysing the industry fact sheet, users can understand the simulation context in its main features. In particular, users should focus their attention on customer sensitivity in order to choose the firm that best matches the potential trend of the market. The customer sensitivity is a critical aspect of market analysis and strategic planning, helping firms anticipate shifts in customer demand and adjust their strategies accordingly. The simulation characterizes the customer sensitivity from four points of view: quality of the product, customer satisfaction, sustainability and price. These impact on the competitiveness of the firm, and are crucial for making informed choices that can enhance customer experience and drive business success.

**Firm fact sheet:** users can review an overall description of the company, the analytics and key performance indicators (in terms of quality of the product, effectiveness of customer satisfaction and impact on sustainability) of the previous virtual year. Energy consumption and carbon footprint are indicated. Each firm is seeking a Sustainability Advisor to start a growth plan for the next two years.

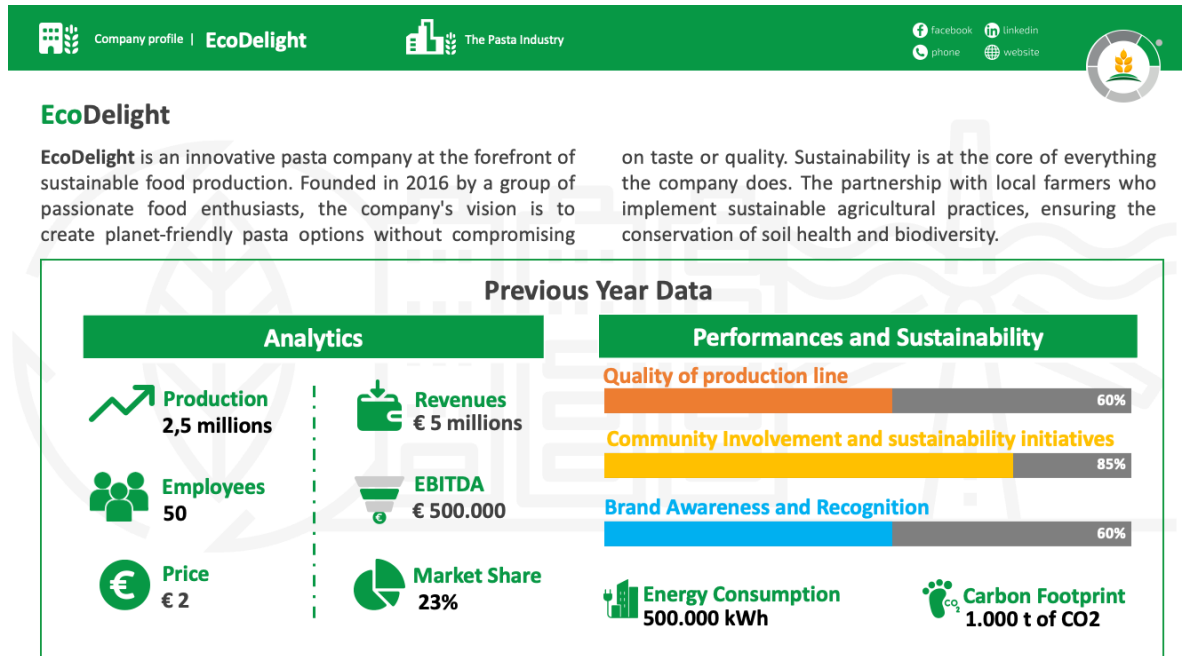


Figure 13. Screenshot – “EcoDelight” fact sheet

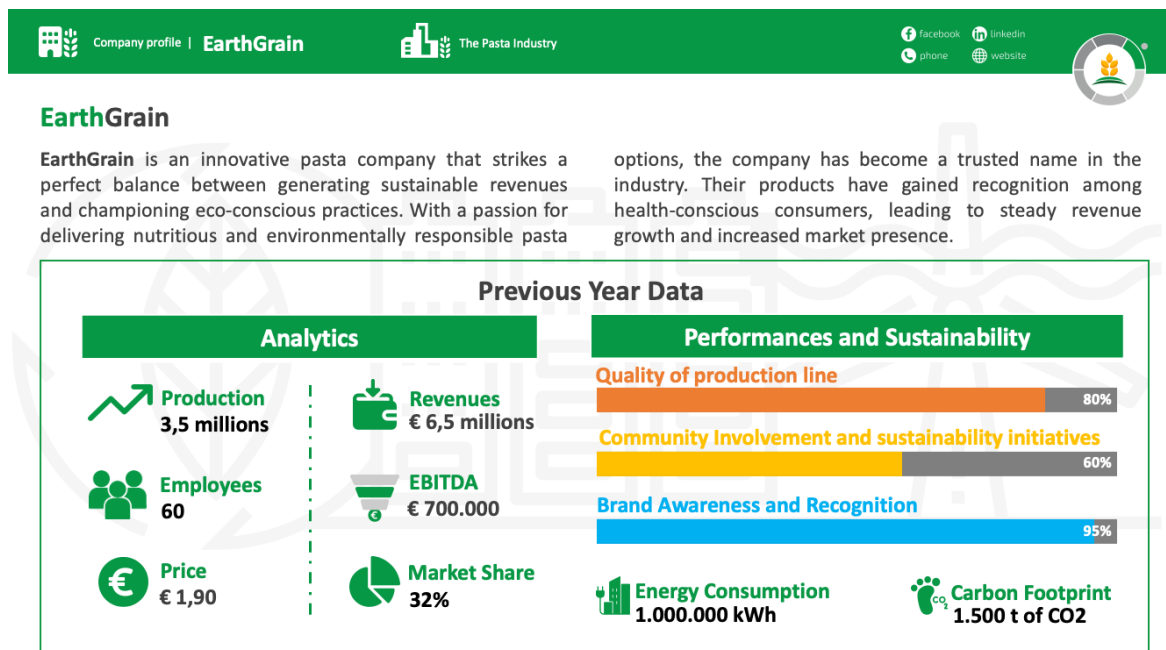


Figure 14. Screenshot – “EarthGrain” fact sheet

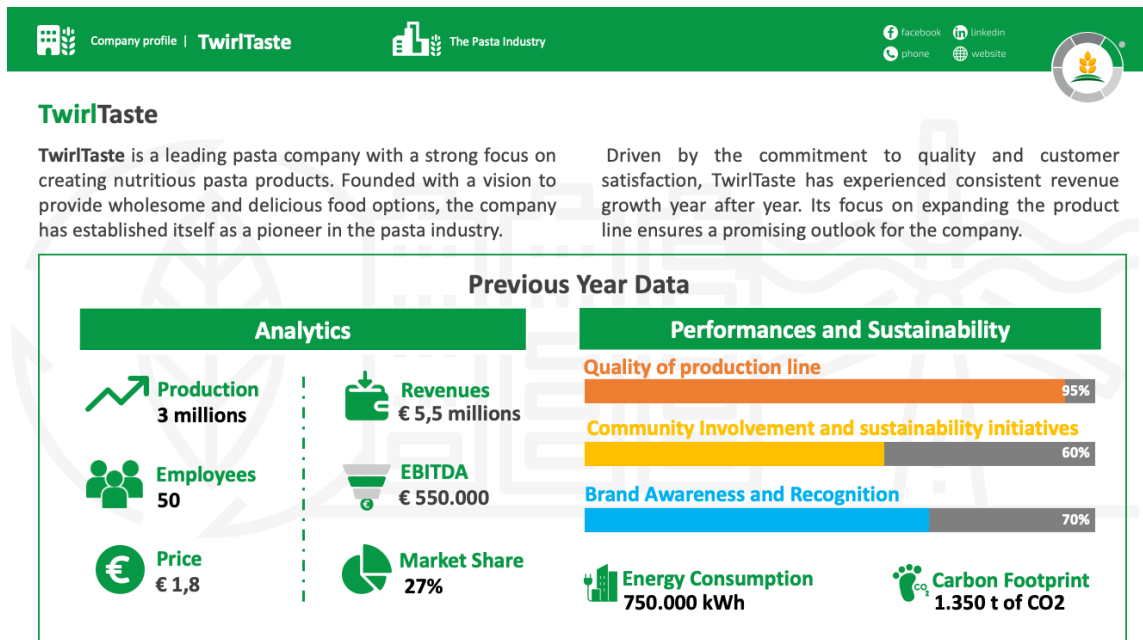


Figure 15. Screenshot – “TwirlTaste” fact sheet

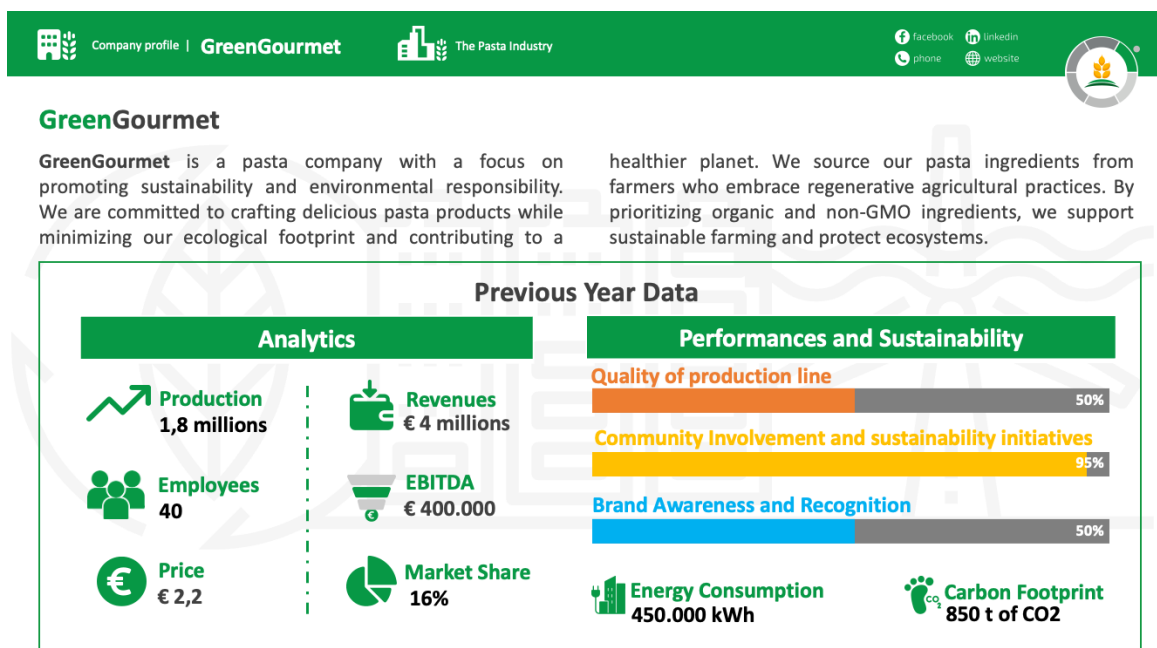


Figure 16. Screenshot – “GreenGourmet” fact sheet

In the first round, users must select a company profile based on the analysis of the fact sheets.

Steps to follow in the first round:

1. Analyse the industry and the firms’ fact sheets;
2. Evaluate which kind of company profile best matches the analysis of the user;
3. Go to the website, insert the credentials and enter the business simulation game interface;

4. Select a firm profile, in order to lead it in the second and third rounds, and click the “confirm” button.

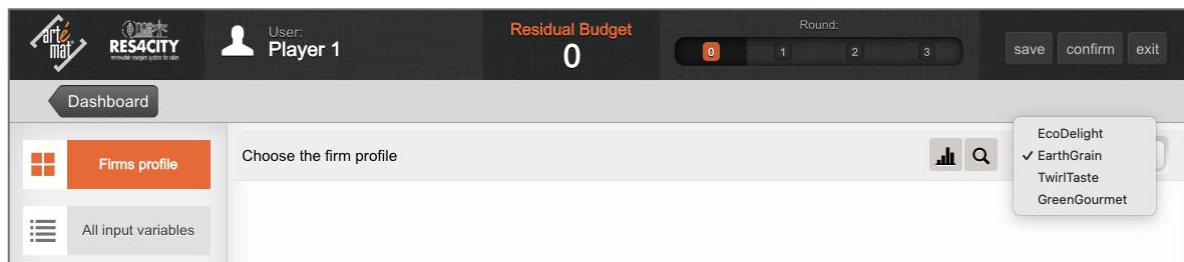


Figure 17. Screenshot – Firms profile

### 3.2.4 RES4CITY Business Simulation Game: Round 2 and 3 – Gaming phase

In the “gaming phase”, users must lead the selected firm competing against 4 virtual players in the same industry. The task is the complete management of the business with the aim to maximise the Market Value in the subsequent 2 virtual years (2 rounds of simulation – each round is a year).

The strategic choices are grouped into **Human Resources, Marketing, and Innovation and Sustainability**. Each “box” contains the input variables.



Figure 18. Screenshot – Functional areas

Users must make decisions (per round) about the main strategic choices of the firm. When the user confirms the strategic decisions, the simulator calculates the results in real time. The user must obtain the highest Market Value in order to win and beat the competitors. The Market Value is calculated on the basis of tangible (e.g. cash flow) and intangible assets (intangible value).

All costs and quantities indicated below are for demonstration purposes only.

#### Budget and forecasts

Users must manage a **budget** of 500.000 euros over the two rounds of simulation. The residual budget can be increased or decreased on the basis of the results obtained. Forecasts (right side of the web interface) help users in determining the resource requirements for the successful execution of a strategy. This includes human resources, budget allocation, technology, and other assets. Accurate resource allocation is critical to avoid overcommitting or under-allocating resources, which can lead to implementation challenges.

Round by round, user can check and evaluate the “**forecast**”: the simulator calculates, in real time, the main potential outputs of the round on the basis of the set of input variables values chosen. In this



way, the user can understand the “potential” impact of the different strategic choices in terms of costs and benefits.

Check the “Game Glossary” to understand the meaning of each term shown in the web interface.

**Production and employees**

The firm has a specific **production capacity**, indicated in the fact sheet, and it can be increased in the third round on the basis of the value of the quality performance obtained in the second round. In particular, the production can increase up to the 10% of its previous value. The firm produces “just in time” in order to minimize or eliminate the need for holding excess inventory. In this way, products are produced or raw materials are ordered only as needed to meet current customer demand. The number of **employees** is also indicated in the fact sheet of the firm and it cannot be increased. The annual salary per each employee is equal to 30.000 euros.

**3.2.5 Strategic Choices**

All costs and quantities indicated below are for demonstration purposes only.

**Strategic choices: Human Resources Area**

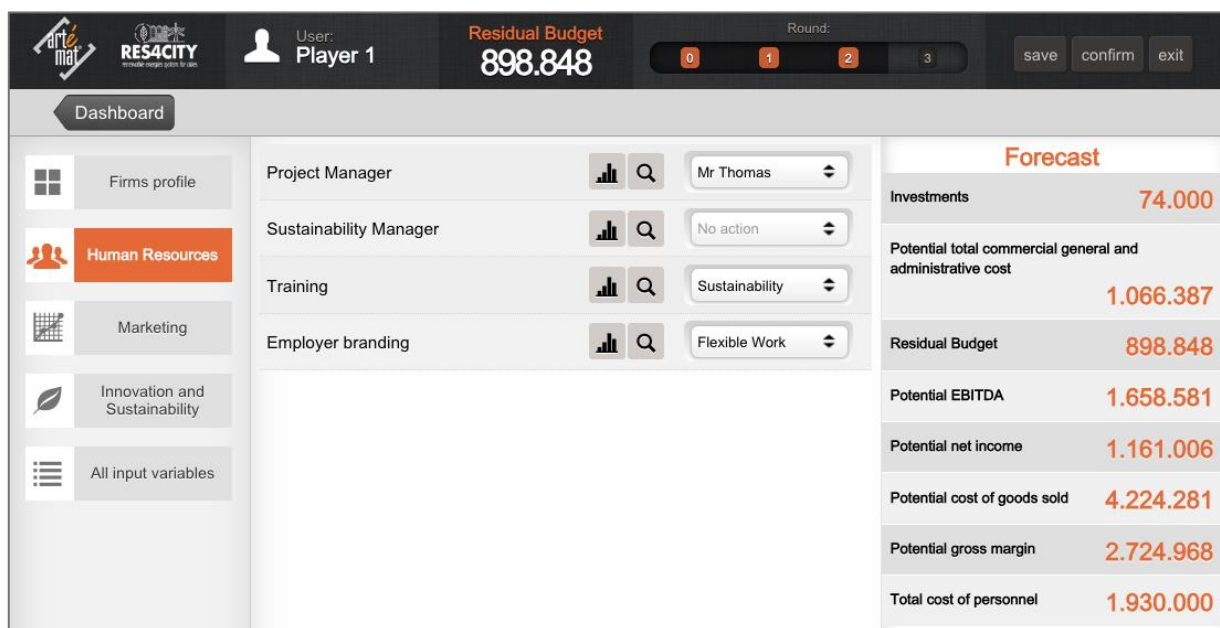


Figure 19. Screenshot – Human Resources Area

**Strategic choice: Sustainability Manager**

(Type: multiple choice)

A Sustainability Manager is a professional who specializes in managing sustainability initiatives, practices, and strategies for an organization. Their role is to guide and oversee sustainability efforts and help the organization achieve its environmental and social responsibility goals. It is possible to choose the Sustainability Manager in the second round (user has the opportunity to hire or not the professional only in the second round and not in the third round): for each CV the skills (expressed in

percentage terms) and the salary expectations are indicated. Any user (human or virtual) can hire each Professional (Ms Martha and Ms Irene): the CV represents a “profile”, not a specific person.



Figure 20. Screenshot – “Ms Martha” profile

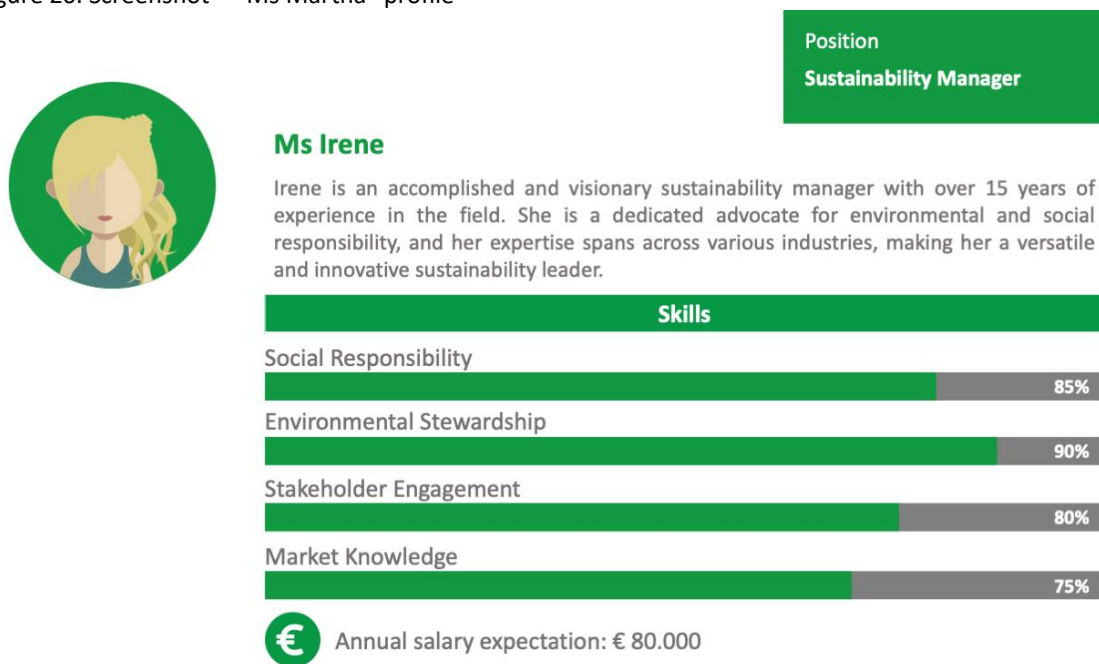


Figure 21. Screenshot – “Ms Irene” profile

**Strategic choice: Project Manager**

(Type: multiple choice)

A Project Manager plays a pivotal role in planning, executing, and closing projects efficiently and effectively. Their responsibilities encompass a wide array of tasks, from defining project objectives to overseeing the successful completion of deliverables. It is possible to choose the Project Manager in



the third round (user has the opportunity to hire or not the professional only in the third round): for each CV the skills (expressed in percentage terms) and the salary expectations are indicated. Any user (human or virtual) can hire each Professional (Ms Ellie and Mr Thomas): the CV represents a “profile”, not a specific person.

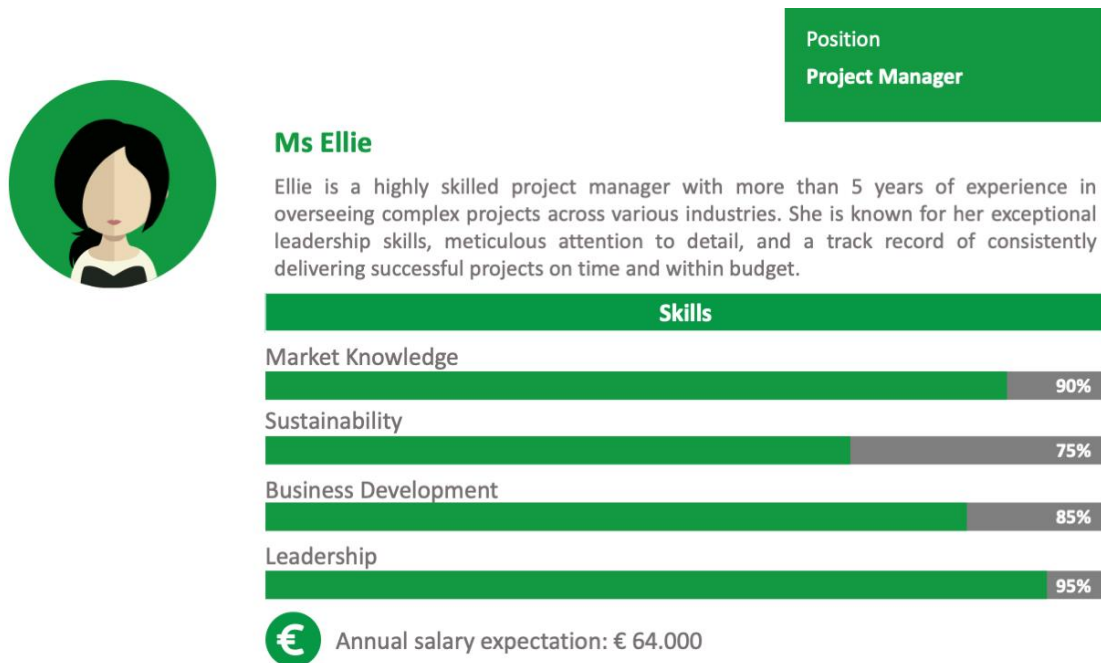


Figure 22. Screenshot – “Ms Ellie” profile

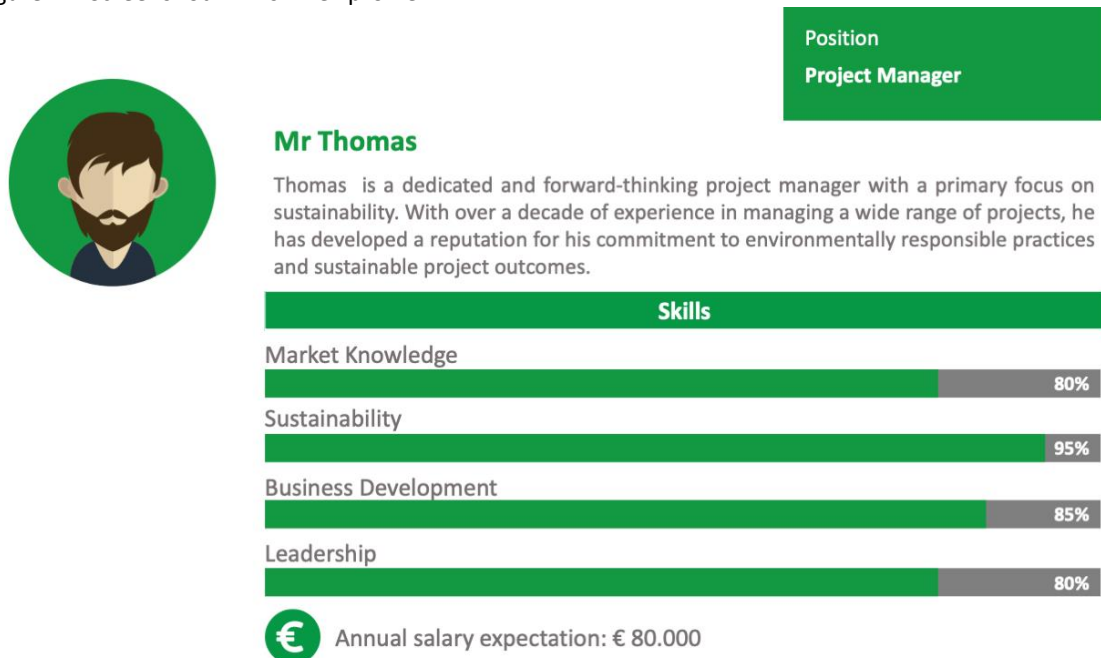


Figure 23. Screenshot – “Mr Thomas” profile

**Strategic choice: Training**

(Type: multiple choice)

A training activity for a firm is a structured program or process designed to enhance the knowledge, skills, and competencies of its employees. These activities are crucial for improving performance and achieving organizational goals.

It is possible to choose among the following topics in the second and third round of simulation (user can choose a specific topic in the second round and a different one in the third round): “Sustainability”, “New Technologies” or “Digital Marketing. Users may decide to not invest, choosing the “No action” option. Each course has a specific cost:

- Sustainability: 50.000 euros.
- New Technologies: 35.000 euros.
- Digital Marketing: 40.000 euros.

**Strategic choice: Employer Branding**

(Type: multiple choice)

Employer branding refers to the process of shaping and promoting a firm's image as an attractive employer. It involves strategic efforts to establish and maintain a positive reputation among current and potential employees.

The variable can be selected in the third round. Three options are available to the user:

- Corporate Social Responsibility (cost of 30.000 euros): it refers to a business approach that contributes to sustainable development by delivering economic, social, and environmental benefits for all stakeholders involved: employees, customers, investors and communities.
- Flexible Work (cost of 24.000 euros): it has become increasingly important in the modern workforce. It offers employees more control over when, where, and how they work, which can lead to increased job satisfaction, work-life balance, and overall well-being.
- No action.

**Strategic choices: Marketing Area**

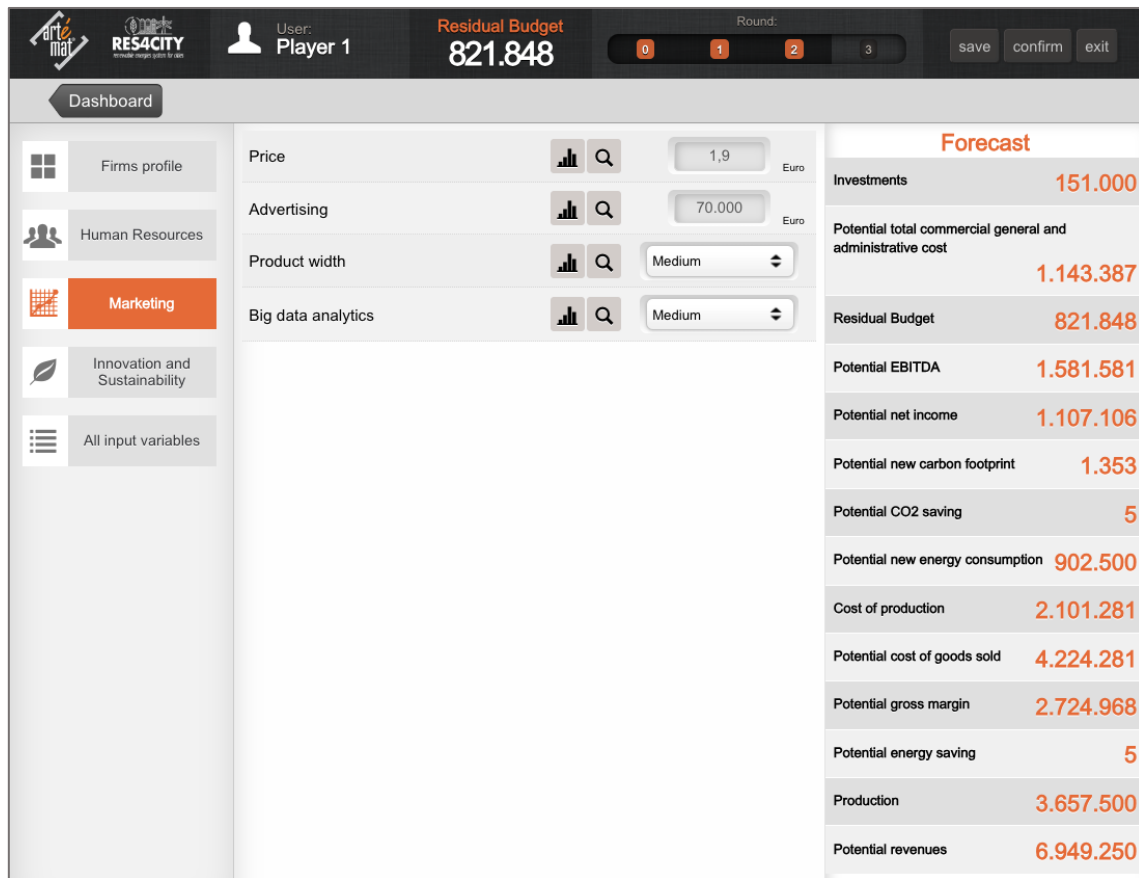


Figure 24. Screenshot – Marketing Area

**Strategic choice: Price**

(Type: number)

The price of the product has a direct impact on customer perception towards the product. It is the only variable actively involved in determining the Price Performance. User can modify the price (range: 1,7-2,3 euros) of the product in the second and third rounds, starting from the price indicated in the fact sheet of the firm chosen in the first round.

**Strategic choice: Product Width**

(Type: multiple choice)

Product width refers to the variety of pasta products that a manufacturer or brand offers. It represents the range of pasta shapes, sizes, and types available to consumers. Product width in the pasta industry can vary widely depending on the company's strategy and target market.

It is possible to modify the variable value in the second and third round. Three options for the user:

- Low: a low variety of pasta products. It generates a cost of 5% on the Raw Materials Cost.
- Medium: a balanced variety of pasta products. It generates a cost of 7,5% on the Raw Materials Cost.
- High: an excellent variety of pasta products. It generates a cost of 10% on the Raw Materials Cost.

**Advertising**

(Type: number)

Advertising in the pasta industry, like any other industry, plays a crucial role in building brand awareness, attracting customers, and increasing sales. Pasta is a widely consumed food product with a competitive market, so effective advertising can help pasta manufacturers and brands stand out. Email, websites, social media, print and outdoor advertising, TV, radio, newspaper, thematic channels, sponsorships can represent different marketing tools. It is possible to modify the variable value in the second and third round (range: 0-100.000 euros). The investment effects end up at the end of each round, then, for the next round you need to invest again in this specific strategic choice.

**Strategic choice: Big Data Analytics**

(Type: multiple choice)

Big data analytics allows companies to make more informed business decisions by examining a large amount of data to uncover hidden patterns, correlations and other insights.

It is possible to modify the variable value in the second and third round. Four options are available for the user:

- Low level. It generates a cost of 5.000 euros.
- Medium level. It generates a cost of 7.000 euros.
- Intensive level: an excellent variety of pasta products. It generates a cost of 10.000 euros.
- No action.

The investment effects end up at the end of each round, then, for the next round you need to invest again in this specific strategic choice.

**Strategic choices: Innovation and Sustainability Area**

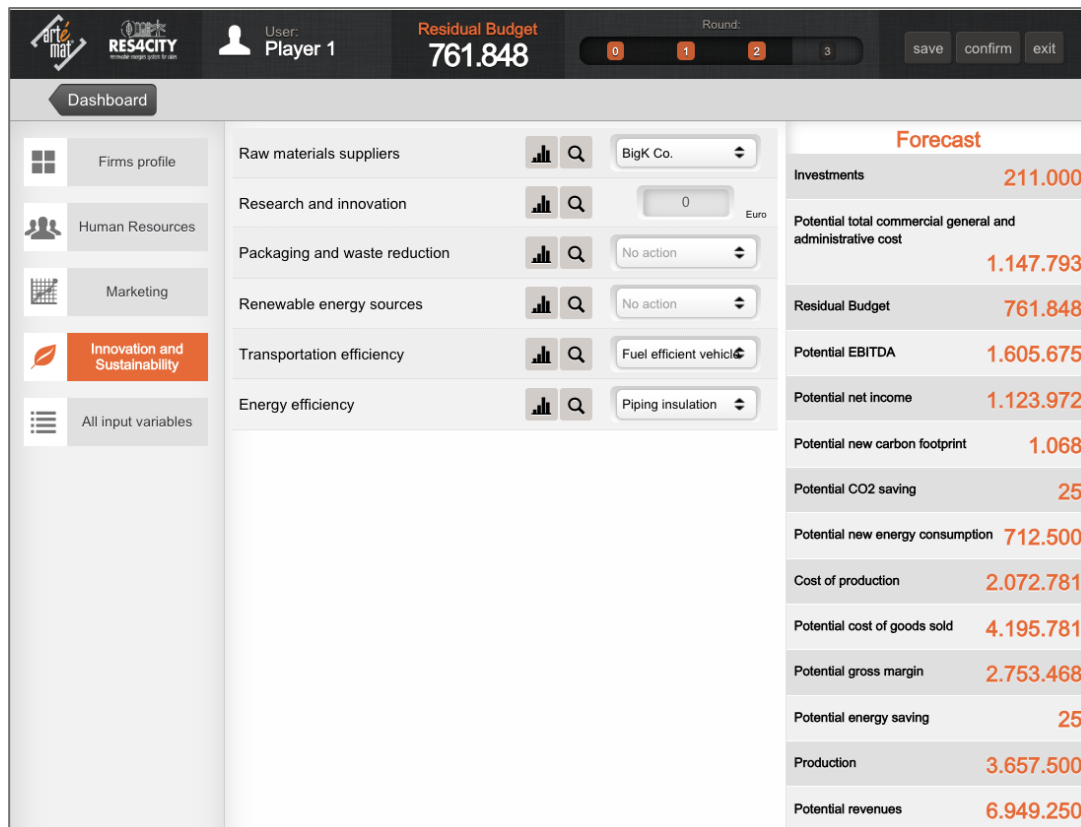


Figure 25. Screenshot – Innovation and Sustainability Area

**Strategic choice: Raw Materials Suppliers**

(Type: multiple choice)

When choosing a raw materials supplier for pasta production, it's essential to consider various factors to ensure the quality, reliability, and sustainability of the supply chain. It is possible to choose the Raw Materials Suppliers in the second round and third round (users can choose a specific profile in the second round and change it in the third round). For each Profile the Key Performance Indicators (expressed in percentage terms) and the cost of raw material per product are indicated.

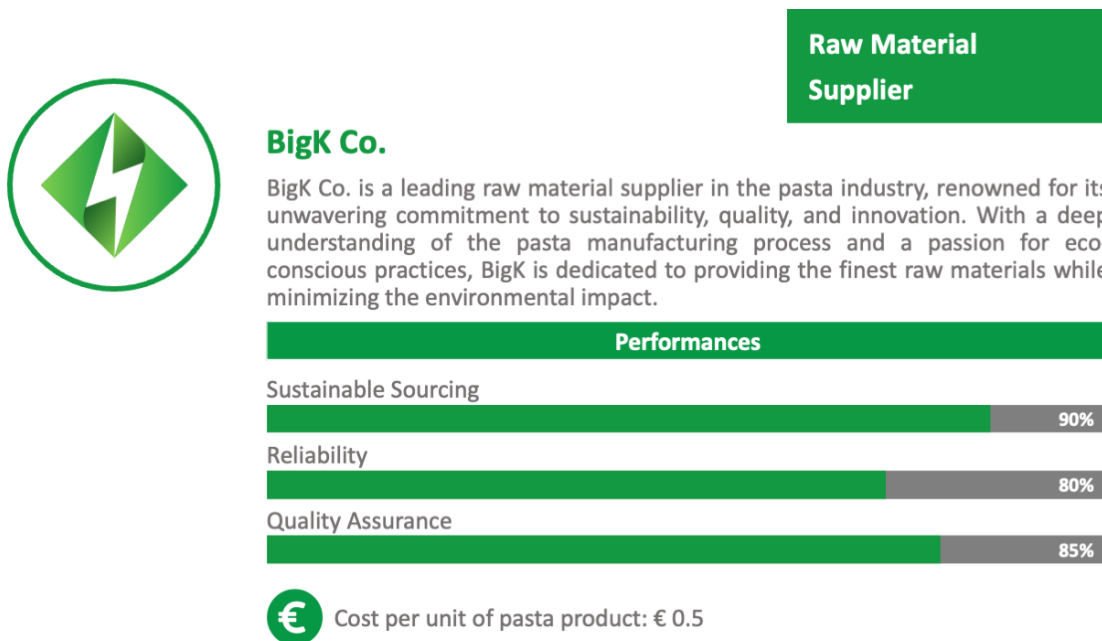


Figure 26. Screenshot – “BigK Co.” profile



Figure 27. Screenshot – “Alchemy” profile

**Strategic choice: Packaging and Waste Reduction**

(Type: multiple choice)

Selecting sustainable packaging for pasta is crucial to reduce the environmental impact and support eco-friendly practices. By adopting a specific packaging and waste reduction strategy, the pasta firm demonstrates its commitment to environmental sustainability and responsibility. These initiatives not only help reduce the firm's environmental impact but also appeal to environmentally conscious consumers, fostering brand loyalty and positive consumer perception.

It is possible to modify the variable value only in the second round. Four options are available to the user:

- **Compostable Packaging Solutions (cost of 40.000 euros):** a pasta firm implements compostable packaging made from plant-based materials, such as cornstarch or sugarcane fibers. These compostable packages are designed to break down naturally in composting facilities, reducing the reliance on traditional plastic packaging that often ends up in landfills. It achieves a high impact on sustainability and costs.
- **Bulk Pasta Dispensers (cost of 20.000 euros):** to minimize single-use packaging, the pasta company introduces bulk pasta dispensers in grocery stores. Customers can bring their reusable containers and fill them with the desired amount of pasta, reducing the need for individual packaging and promoting zero-waste shopping. It achieves a high impact on sustainability and a low impact on customer satisfaction.
- **Minimalist Design (cost of 30.000 euros):** Aim for minimalist packaging designs that use the least amount of materials necessary to protect and preserve the pasta. Simple designs can help reduce the overall environmental footprint. It achieves a high impact on customer satisfaction.
- **No action.**

**Strategic choice: Renewable energy sources**

(Type: multiple choice)

By adopting renewable energy sources, the firm can significantly decrease its greenhouse gas emissions, contribute to global efforts in mitigating climate change, and enhance its overall sustainability profile. Embracing these solutions not only benefits the environment but also showcases the industry's commitment to responsible practices and a greener future.

It is possible to modify the variable value only in the second round. Four options are available to the user:

- **Solar Power (cost of 200.000 euros):** the firm can install solar panels on its rooftops and open spaces to harness solar energy. The solar panels convert sunlight into electricity, which is used to power various operations in the factory, such as milling, mixing, and drying processes. By relying on solar power, the company reduces its dependence on grid electricity, lowers greenhouse gas emissions, and saves on energy costs in the long run.
- **Biomass Energy (cost of 300.000 euros):** the firm can implement a biomass energy system that utilizes pasta waste, such as trimmings and scraps, as a renewable energy source. The waste is converted into biogas through anaerobic digestion, which is then used to generate heat and electricity for the production facility. This approach not only reduces waste but also turns it into a valuable resource for energy production.
- **Geothermal Heating (cost of 400.000 euros):** the firm can invest in geothermal heating systems for its drying processes. Geothermal energy is sourced from the earth's natural heat, providing a consistent and sustainable energy supply to dry pasta. This energy-efficient method significantly reduces the plant's carbon emissions compared to conventional heating methods.

**Strategic choice: Research and Innovation**

(Type: number)

The investments in research and innovation play a very important role in the pasta industry, allowing companies to develop new products, improve existing ones, enhance production processes, and meet evolving consumer demands. It is possible to modify the variable value in the second and third round (range: 0-150.000 euros). The investment effects end up at the end of each round, then, for the next round you need to invest again in this specific strategic choice.

**Strategic choice: Transportation efficiency**

(Type: multiple choice)

Transportation efficiency is fundamental to ensuring the timely and cost-effective delivery of pasta products from manufacturers to distributors, retailers, and ultimately consumers. Efficient transportation not only reduces costs but also minimizes environmental impact and helps maintain the quality of pasta products during transit.

It is possible to modify the variable value only in the third round. Three options are available to the user:

- Consolidation and Batch Shipping (cost of 60.000 euros): the firm collaborates with retailers and distributors to consolidate orders and batch shipments. By combining multiple orders into fewer deliveries, they can reduce the number of trips made by delivery vehicles, resulting in fuel savings and lower emissions. It leads to a decrease in logistic costs of 10%.
- Fuel Efficient Vehicles (cost of 40.000 euros): the firm upgrades its delivery fleet to include fuel-efficient vehicles. These vehicles may be hybrids, electric, or those with advanced fuel-saving technologies, ensuring a reduced carbon footprint while delivering pasta products. It leads to a decrease in logistic costs of 8%.
- No action.

**Strategic choice: Energy efficiency**

(Type: multiple choice)

Energy efficiency can lead to cost savings, reduced environmental impact, and enhanced sustainability. The pasta manufacturing process involves various stages, including milling, dough preparation, extrusion, drying, and packaging, all of which consume energy. Improving energy efficiency not only benefits the bottom line but also aligns with corporate sustainability goals and contributes to a reduced carbon footprint. It is possible to modify the variable value only in the second round. Four options are available to the user:

- Piping Insulation (cost of 20.000 euros): it helps maintain the temperature of fluids being transported through pipes, prevents heat loss, and reduces energy consumption. Properly insulated piping also contributes to safety, protecting against burns or injuries resulting from contact with hot surfaces.
- More efficient devices (cost of 30.000 euros): there are many benefits from the implementation of more efficient devices and technologies to improve production processes, reduce energy consumption, and enhance overall operational efficiency.
- Envelope Insulation (cost of 40.000 euros): it refers to the insulation of a building's envelope, which includes the outer shell or skin of the building, typically consisting of the walls, roof, and windows. Proper envelope insulation is essential for energy efficiency, temperature control, and maintaining a comfortable indoor environment.
- No action.



### 3.2.6 Energy consumption and carbon footprint

Energy consumption and carbon footprint represent two fundamental dimensions in determining the sustainability performance of the firm.

**Energy consumption** indicates the amount of energy, typically in the form of electricity, natural gas, or other energy sources, that a firm uses to power its operations. It includes the energy required to operate machinery (milling, mixing, kneading, extrusion, shaping, drying and packaging), lighting, office equipment, and any other energy-dependent processes within the firm.

**Carbon footprint** refers to the total amount of greenhouse gas emissions generated by the firm's operations throughout its entire value chain. This includes emissions from production, energy use, transportation, manufacturing processes, packaging, and distribution. Reducing the carbon footprint is a critical aspect of sustainability and corporate responsibility.

In the second and third round, the starting values of energy consumption and carbon footprint (based on the firm chosen in the first round) can be decreased or increased on the basis of the strategy implemented in terms of raw materials suppliers, packaging and waste reduction, renewable energy sources, transportation efficiency and energy efficiency.

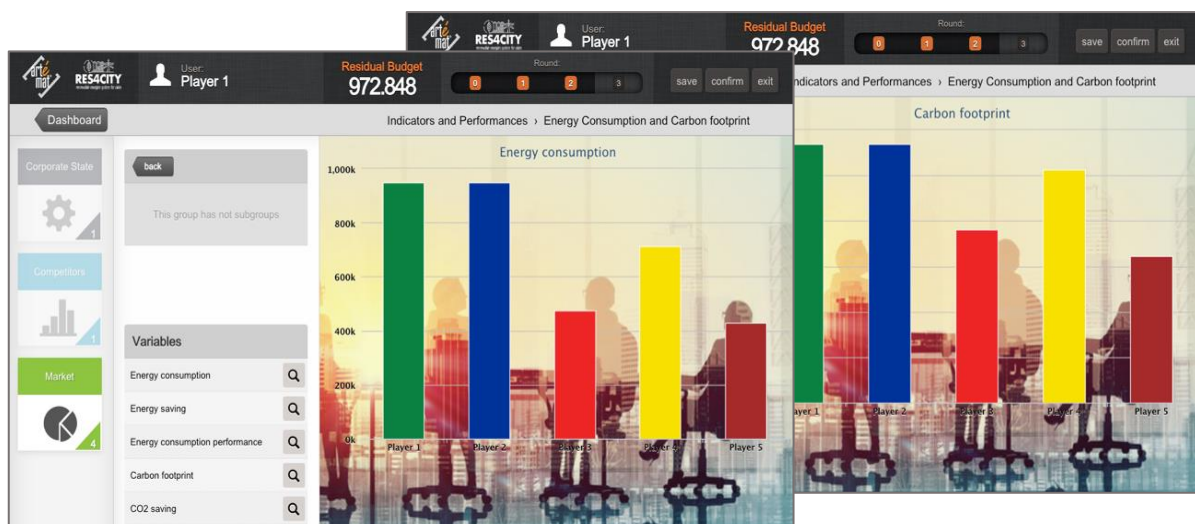


Figure 28. Screenshots – Energy consumption and carbon footprint

### 3.2.7 Performances and Competitiveness

In the simulation scenario, performance reflects the effectiveness and efficiency of the firm in achieving specific objectives and goals. Performance measurement and evaluation is crucial to understand the results obtained in the current round and to identify strengths and weaknesses in order to modify or change the strategy in the next round. Recalibrating a strategy allows a company to review and adjust the previous strategy to face changing circumstances, respond to new market dynamics, and ensure that the firm remains aligned with its objectives.

The simulator converts each strategic choice (input variable) into an indicator, between 0 and 1, that represents the impact on the market. The higher the “value” of a strategic choice, the higher the relative indicator. The opposite logic holds for the evaluation of the price.

Later, the simulator evaluates and compares the strategies of the virtual firms from different points of view (performances) and at different levels (level I and II). Performances of level I are calculated as



the weighted sum of a set of indicators, while performances of level II are calculated as a weighted sum of a set of indicators and performances of level I and taking into considerations the features of the firm chosen in the first round.

### Level I performance

- **Energy consumption performance:** this is a function of each of the following - raw materials suppliers' indicator, packaging and waste reduction indicator, renewable energy sources indicator, transportation efficiency indicator (only in the round 3) and energy efficiency (only in the round 3).
- **Carbon footprint performance:** this is a function of each of the following - raw materials suppliers' indicator, packaging and waste reduction indicator, renewable energy sources indicator, transportation efficiency indicator (only in the round 3) and energy efficiency (only in the round 3).



Figure 29. Screenshots – Energy consumption and carbon footprint performance

### Level II performance

- **Quality Performance:** this is a function of the starting value of “quality” of the chosen firm, sustainability manager indicator, training indicator, research and innovation indicator, raw materials suppliers' indicator, project manager indicator (only in the round 3) and employer branding indicator (only in the round 3).
- **Customer Satisfaction Performance:** this is a function of the starting value of “customer satisfaction” of the chosen firm, sustainability manager indicator, training indicator, product width indicator, advertising indicator, big data analytics indicator and project manager indicator (only in the round 3).
- **Sustainability Performance:** this is a function of the starting value of “sustainability” of the chosen firm, sustainability manager indicator, training indicator, energy consumption performance, carbon footprint performance, project manager indicator (only in the round 3) and employer branding indicator (only in the round 3).
- **Price Performance:** this is a function of the price chosen.

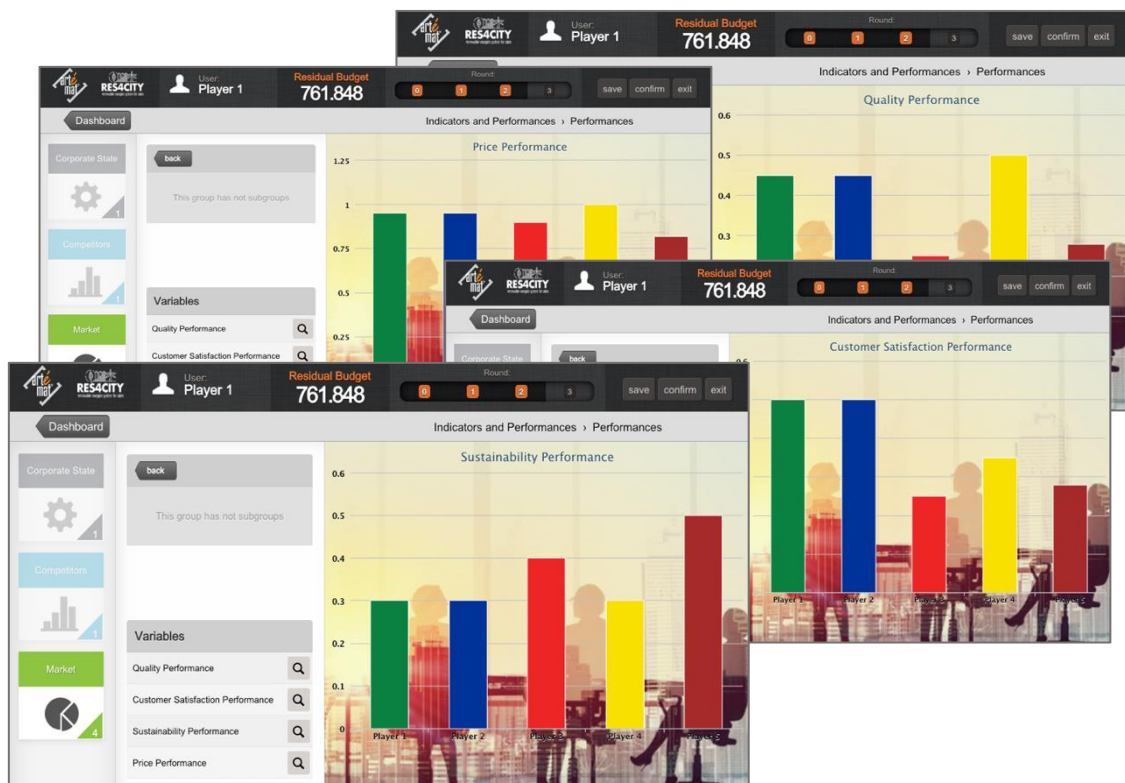


Figure 30. Screenshots – Quality, Customer Satisfaction, Sustainability and Price performance

### Competitiveness

The weighted sum of the performances of level II determines the competitiveness in the market of the firm. The competitiveness of each virtual firm represents the outcome of the strategic decisions: the higher the competitiveness, the higher the **market share** in terms of number of products sold. The overall demand is shared among the different virtual firms on the basis of their competitiveness.



Figure 31. Screenshot – Competitiveness

### 3.2.8 Economic Reports

The economic reports consist of the Income Statement, the Balance Sheet and the Cash Flows Statement, and represent the synthesis of the economic results achieved by the firm during each round. The reports are primarily expressed in terms of financial analysis: in particular, the income statement is showed using the scheme of the cost of goods sold. The balance sheet is showed using the functional criterion. The Cash Flows Statement is the basis for calculating the market value.

#### Income Statement

The Income Statement is one of the key financial statements used in accounting and financial reporting. It provides a summary of a firm's financial performance over a specific period: the simulator generates an income statement per each round (one year of operability of the firm). The income statement presents revenues, costs, and profits (or losses) and is an essential tool for assessing the firm's profitability. The income statement is structured as follows:

- **Revenue:** This is the top line of the income statement and represents the total amount of money generated by the firm from its primary operations, in terms of sales of goods (pasta products).
- **Cost of Goods Sold:** it represents the direct costs associated with producing the products sold. These costs include raw materials, salaries, energy, and any other expenses directly tied to production.
- **Gross Margin:** it is calculated by subtracting cost of goods sold from revenue. It reflects the profit a firm makes from its core operations before considering operating costs.
- **Selling, General and Administrative Costs (operating costs):** it includes logistic and selling costs, advertising, big data analytics, employer branding, research and innovation, and the costs refer to the sustainability (packaging and waste reduction, renewable energy sources, transportation and energy efficiency).
- **EBITDA:** it stands for Earnings Before Interest, Taxes, Depreciation, and Amortization. It is a financial metric that is often used to evaluate a firm's operating performance and financial health. EBITDA is calculated by taking a firm's gross margin and subtracting selling, general and administrative cost.
- **Depreciation and Amortization:** Depreciation is a non-cash accounting expense that reflects the allocation of the cost of long-term assets (like buildings and machinery) over their useful life. Amortization is similar to depreciation but typically related to intangible assets, such as patents or trademarks. Like depreciation, amortization is a non-cash expense. For simplification, the simulator does not consider depreciations and amortizations.
- **EBIT:** it stands Earnings Before Interest, Taxes. It is a financial metric used to assess a firm's operating profitability by measuring its earnings before accounting for interest expenses and income tax. EBIT provides insight into how well a firm's core operations are performing without the influence of financial leverage (interest) and tax considerations. For simplification, the simulator does not consider EBIT because, without depreciations and amortizations, this value is equal to EBITDA.
- **Interest:** Interest expenses represent the cost of borrowing money, such as loans, and are not considered part of a firm's operating performance. For simplification, the simulator does not consider loans.
- **Income Before Taxes:** This is the total income or profit before accounting for income taxes. For simplification, the simulator does not consider Income Before Taxes because, without interest, depreciations and amortizations, this value is equal to EBITDA.

- **Taxes:** the income tax owed by the firm based on its taxable income. It is calculated using the applicable tax rate.
- **Net Income:** Net income is the bottom line of the income statement and is calculated by subtracting income tax expense from EBITDA. It represents the firm’s profit after all expenses, including taxes.

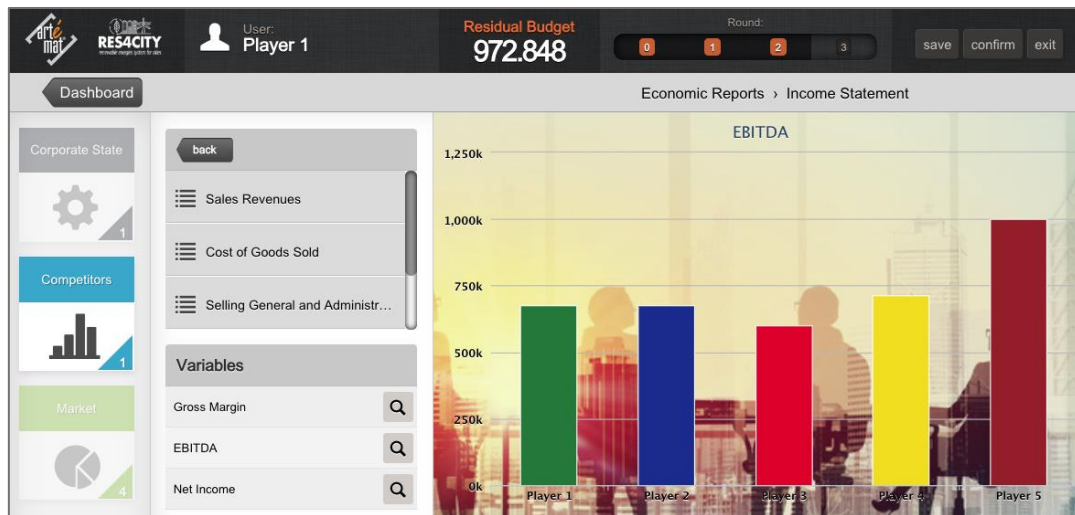


Figure 32. Screenshot – EBITDA

**Balance Sheet (simplification)**

A Balance Sheet is used in accounting and finance to provide a snapshot of a firm's financial health at a specific point in time: the simulator generates a balance sheet per each round (one year of operability of the firm). The balance sheet shows the firm's assets and liabilities, as follows:

**Assets**

**Cash:** it represents the total amount of money and cash equivalents that a firm holds at a specific point in time (per each round).

**Total Assets:** it represents the sum of all the firm's assets, both current and non-current, at a specific point in time. For simplification, the simulator considers only cash.

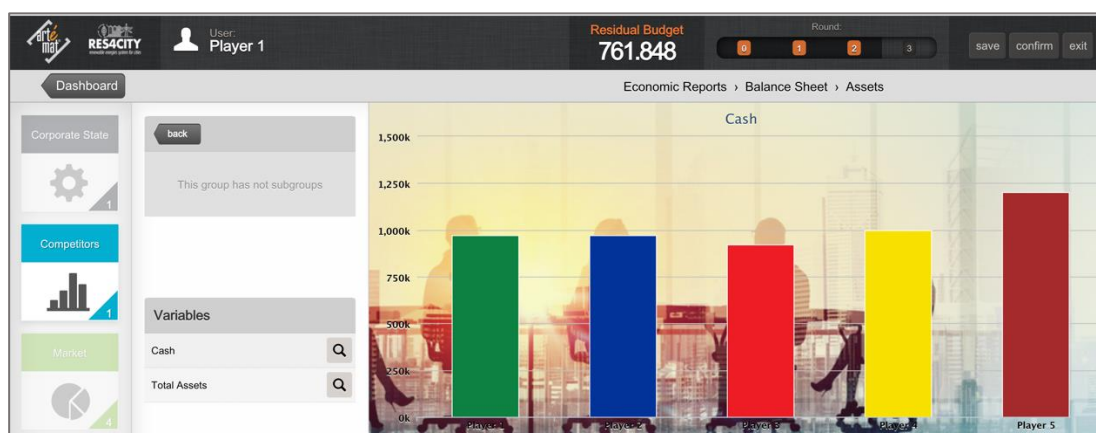


Figure 33. Screenshot – Cash

### Liabilities

**Capital Stock:** it represents the total number of shares that the firm is authorized to issue according to its corporate charter or articles of incorporation. It represents the maximum number of shares that the company can legally issue to shareholders.

**Retained earnings:** Retained earnings are the cumulative net profits or losses earned by a company over its global operativity.

**Total Net Worth:** It considers the capital stock and retained earnings.

### Cash Flow Statement (simplification)

**Free Cash Flow To The Firm (FCFF):** it is a financial metric that represents the cash flows available to all of a firm's investors, including both debt and equity holders. FCFF is a crucial measure of a firm's financial performance, as it assesses the cash generated by the core operations of the business after accounting for all operating and capital costs. FCFF is the basis of determining the Market Value of the firm. EBITDA, Change in Working Capital, Capital Expenditures and Taxes on EBIT determine the FCFF value:

$$FCFF = EBITDA - (Change\ in\ working\ capital + Capital\ Expenditures + Taxes\ on\ EBIT)$$

**Change in working capital:** it measures the difference in a firm's working capital from one period to another. Working capital is a crucial measure of a firm's short-term financial health and its ability to meet its day-to-day operational needs. Working capital represents the difference between a firm's current assets (in terms of account receivables and closing inventory) and current liabilities (in terms of account payables). For simplification, the simulator does not consider Working capital.

**Capital Expenditures:** Capital expenditures represent the cash spent on investments in property, plant, equipment, and other long-term assets. it is subtracted from operating cash flow because it is considered a cash outflow for the firm. For simplification, the simulator does not consider Capital Expenditures.

For simplification, the simulator calculates FCFF with the following formula:

$$FCFF = EBITDA - Taxes\ on\ EBITDA$$



Figure 34. Screenshot – Free Cash Flow To The Firm



### 3.2.9 Intellectual capital

Intellectual capital represents the intangible assets of a firm that contribute to its value and overall success. It is a fundamental concept in the knowledge-based economy, where innovation, information, and intellectual assets are of increasing importance. These intangible assets are distinct from physical or financial assets and are often knowledge-based. Intellectual capital encompasses a wide range of elements that are not physical but are critical for a firm's performance and sustainability. Firms that effectively manage their intellectual capital can gain a competitive edge by fostering innovation, optimizing processes, and leveraging their intangible assets to create value. Intellectual capital is particularly relevant in industries driven by technology, research and development, and knowledge-intensive activities. It represents the collective intellectual resources of an organization and plays a crucial role in long-term success. The simulator considers the importance of intellectual capital in determining the market value of the firm. Intellectual capital is structured in three primary components/assets: Human, Relational and Structural Capital. The simulator, per each round, calculates three relative indices:

- **Human Capital Index:** human capital represents the knowledge, skills, expertise, experience, and creativity of a firm's employees. It includes the talent, capabilities, and intellectual contributions of the workforce. Human capital is essential for problem-solving, innovation, and the execution of a firm's strategies. The human capital index is a function of the training indicator, employer branding indicator (only in round 3), sustainability manager indicator and project manager indicator (only in round 3).
- **Structural Capital Index:** structural capital includes the intangible assets embedded within an organization's structure, processes, and systems. It includes items like patents, trademarks, copyrights, databases, proprietary software, organizational culture, sustainability, and business methodologies. Structural capital represents the institutional knowledge and intellectual property that the organization has developed over time. The structural capital index is a function of energy consumption performance, carbon footprint performance, and the research and innovation indicator.
- **Relational Capital Index:** Relational capital pertains to the value created from external relationships, including those with customers, suppliers, partners, and other stakeholders. It covers brand reputation, customer loyalty, and the network of business relationships that enhance a firm's market position and competitiveness. The relational capital index is function of the advertising indicator, big data analytics indicator, packaging and waste reduction indicator, and employer branding indicator (only in the round 3).

The **Intellectual Capital Performance** is the weighted sum of Human, Relational and Structural Capital Index.

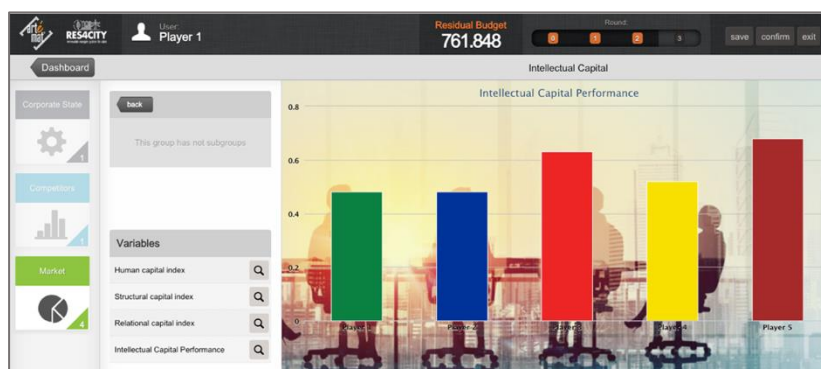


Figure 35. Screenshot – Intellectual Capital Performance

### 3.2.10 Market Success

The **Market Value** determines the firm’s success and it is an important financial metric used to assess the firm's size and overall market perception. The value of a firm on the market is a key consideration for investors and stakeholders when assessing a firm's financial health, stability, and overall value. It is also relevant in the context of valuing the company's stock or ownership shares in the open market. The simulator calculates the market value as the sum of three main contributions: the Asset Value, the Intangible Value and the Cash. The **Asset Value** depends on the FCFF (Free Cash Flow to the Firm): a discounted cash flow for each round. The discounting is done using the WACC - Weighted Average Cost of Capital (18%). The **Intangible Value** is calculated as a percentage of FCFF obtained in the running round, further weighted by the Intellectual Capital Performance of the running round.

$$\text{Market Value} = \text{Asset Value} + \text{Intangible Value} + \text{Cash}$$

The simulator identifies the user (human or virtual) that obtains the highest Market Value as the winner of the competition.



Figure 36. Screenshot – Market Value



### 3.2.11 How to play

#### How to access the web interface game

Users can access the simulation environment through a link and a set of credentials (username and password).

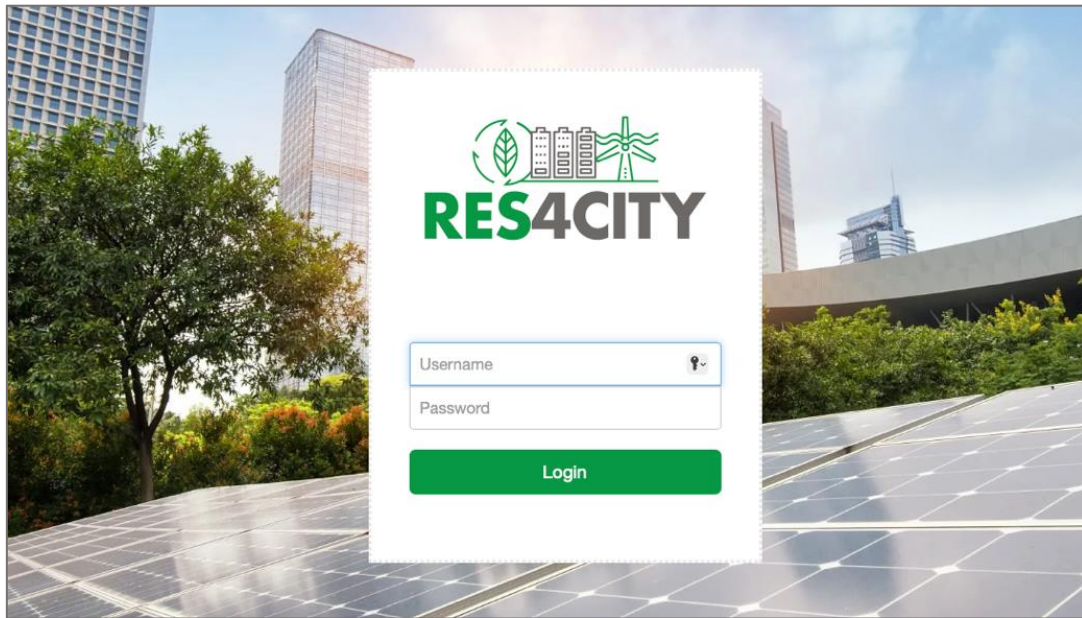


Figure 37. Screenshot – Login web page

#### Web interface features

Below are screenshots of the user-friendly web interface of the Business Simulation Game:

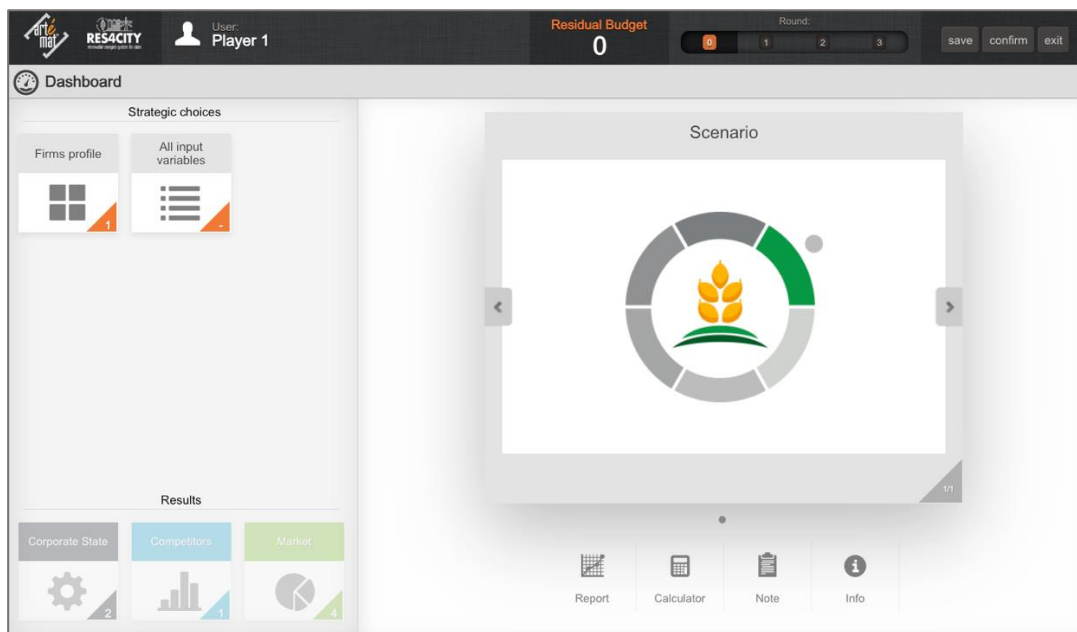


Figure 38. Screenshot – Web interface: round 1

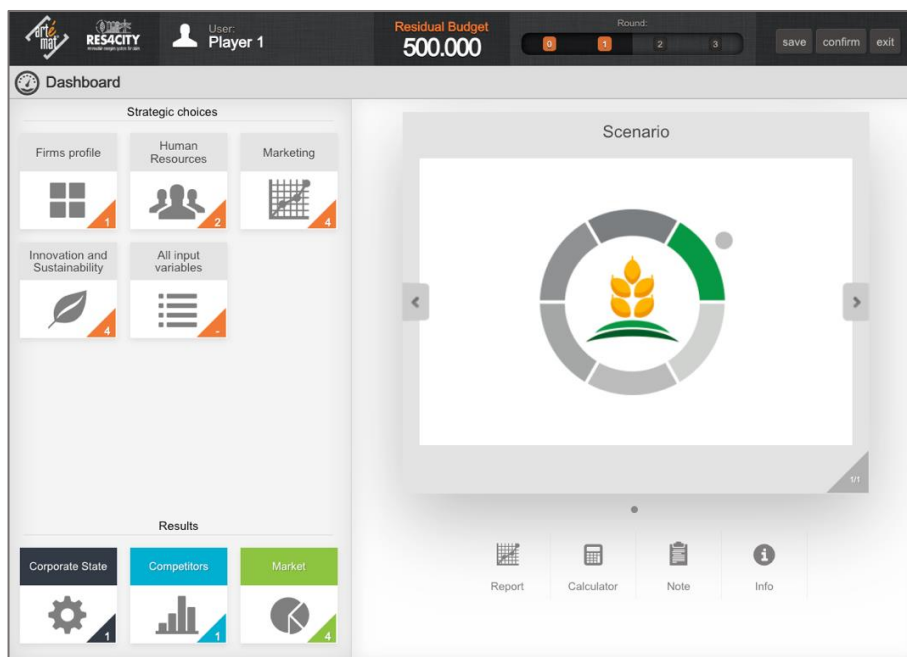


Figure 39. Screenshot – Web interface: round 2 and 3

There are different sections of the web interface: a black bar (upper side) indicates the name of the user, the budget, the number of rounds and three buttons: “save” button to save the strategic choices (user has the opportunity to modify them), “confirm” button to save in definitive way the strategic choices (user cannot modify the strategic choices after clicking on the confirm button) and the “exit” button.

On the left side the user can choose the values of strategic variables: each box (“Firms profile”, “Human Resources”, “Marketing”, and “Innovation and Sustainability”) includes a set of strategic choices. On the lower left, upon closing round 2, users can check the results of the game clicking on the “Market”, “Competitor” and “Corporate State” boxes. On the right side a slideshow of the simulation scenario and the buttons “Report” (overview of the results obtained in the current round), “Calculator” and “Note” complete the functionalities of the web interface.

Income Statement		Assets		Liabilities	
Revenues	4.984.080	Cash	972.848	Capital Stock	500.000
Raw materials cost	1.311.600	Total Assets	972.848	Retained earnings	472.848
Energy cost	171.000			Total Net Worth	972.848
Production cost	1.580.970				
Employees cost	1.800.000				
Training cost	0				
Total personnel cost	1.800.000				
Overheads	180.000				
Total cost of goods sold	3.560.970				
Gross Margin	1.423.110				
Logistic cost	498.408				
Selling cost	249.204				
Advertising cost	0				
Big data analytics cost	0				
Research and innovation cost	0				
Packaging and waste reduction cost	0				
Renewable energy sources cost	0				
Total commercial general and administrative costs	747.612				
EBITDA	675.498				

Performances - FCFE - Intellectual Capital - Success	
Energy consumption	950.000
Energy saving	5 %
Energy consumption performance	0,45
Carbon footprint	1.425
CO2 saving	5 %
Carbon footprint performance	0,57
Quality Performance	0,45
Customer Satisfaction Performance	0,5
Sustainability Performance	0,3
Price Performance	0,95
Free Cash Flow To The Firm	472.848
Asset Value	1.597.794
Intellectual Capital Performance	0,48
Intangible Value	169.046

Figure 40. Screenshot – Report

**How to make decisions**

In the first round, users select a firm profile form the dropdown menu. Then users may click on the “confirm” button.

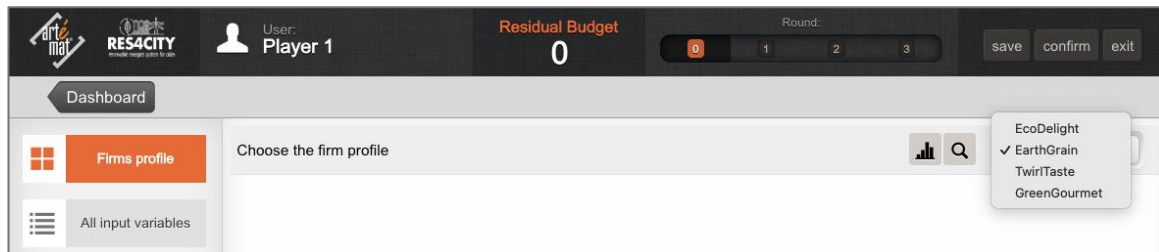


Figure 41. Screenshot – Firms profile: Choose the firm profile

In round 2 and 3, users can choose the variable values clicking on the different boxes “Human Resources”, “Marketing”, and “Innovation and Sustainability”. Each box (functional area) includes four or more strategic choices. Users make decisions clicking within the white box or on the dropdown menu. In the column on the right side, it is possible to check, in real time, the forecasts on the basis of the decisions taken. Each “decision” impacts on one side, costs and on the other side, performance.

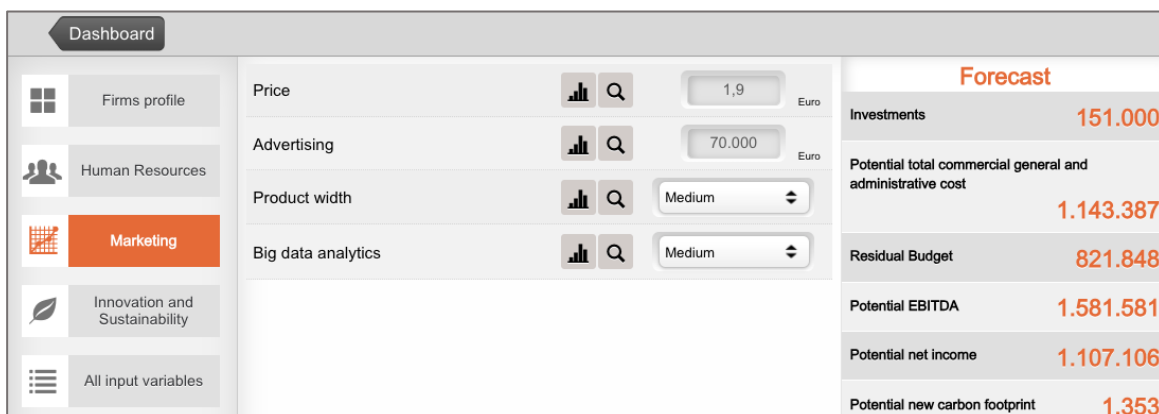


Figure 42. Screenshot – Marketing area: strategic choices

By clicking on the “hand lens” button, users can check a description of the variable. The “histogram” button allows users to check the variable value chosen in the previous round.



Figure 43. Screenshot – “histogram” and “hand lens” button

By clicking on the “All input variables” box, it is possible to have an overview on the strategy implemented (all the variable values in one screen).

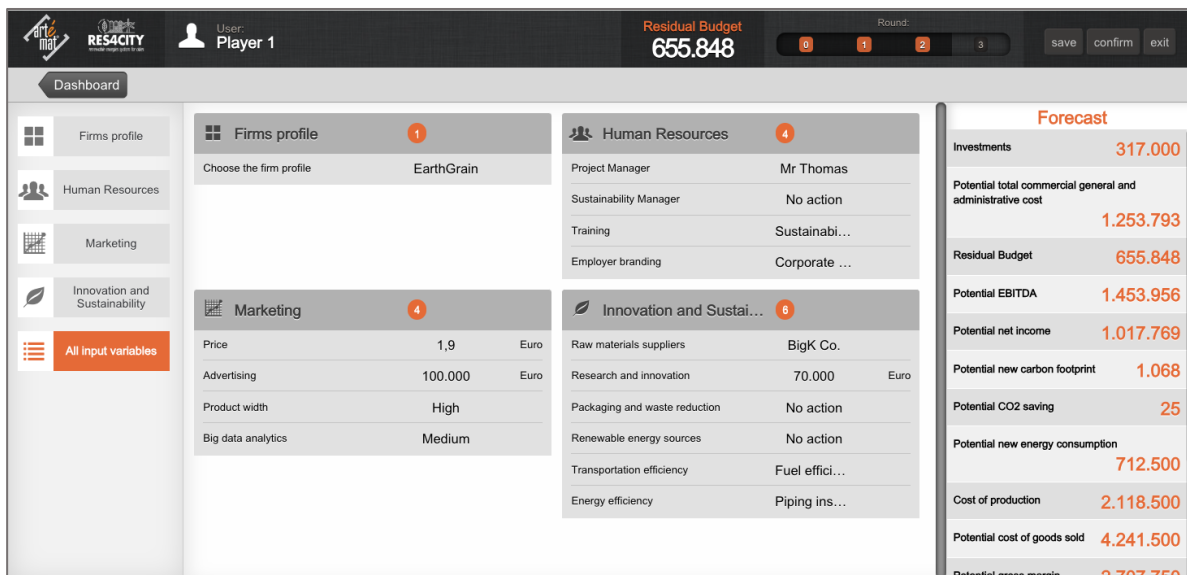


Figure 44. Screenshot – All input variables

**How to check the results of game**

When the user “confirms” the strategic decisions, the simulator calculates the results in real time. The results of the game, per each round, are shown in the “Market”, “Competitor” and “Corporate State” boxes (lower left).

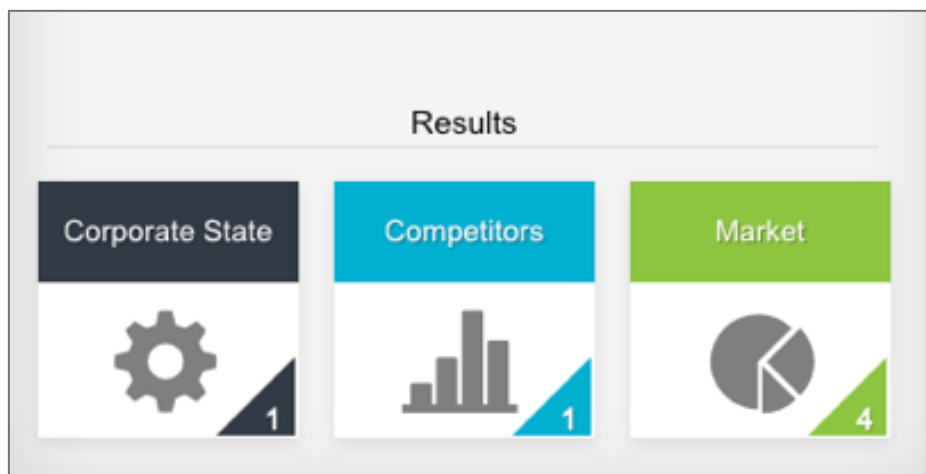


Figure 45. Screenshot – “Results” section

In order to check and evaluate the most important output, the Market Value, users may click on the “Market” box, then scroll and click on “Success” and then on Market Value.



Figure 46. Screenshot – How to navigate the web interface/1



Figure 47. Screenshot – “Market Value” trend

By clicking on buttons “2” and “3”, it is possible to check and analyse the trend of the specific indicator over the rounds of simulation. Then, it is possible to check “Asset Value” and “Intangible Value”. By clicking on the “back” button, it is also possible to check “Indicators and Performances”, “Competitiveness and Sales” and “Intellectual Capital”.

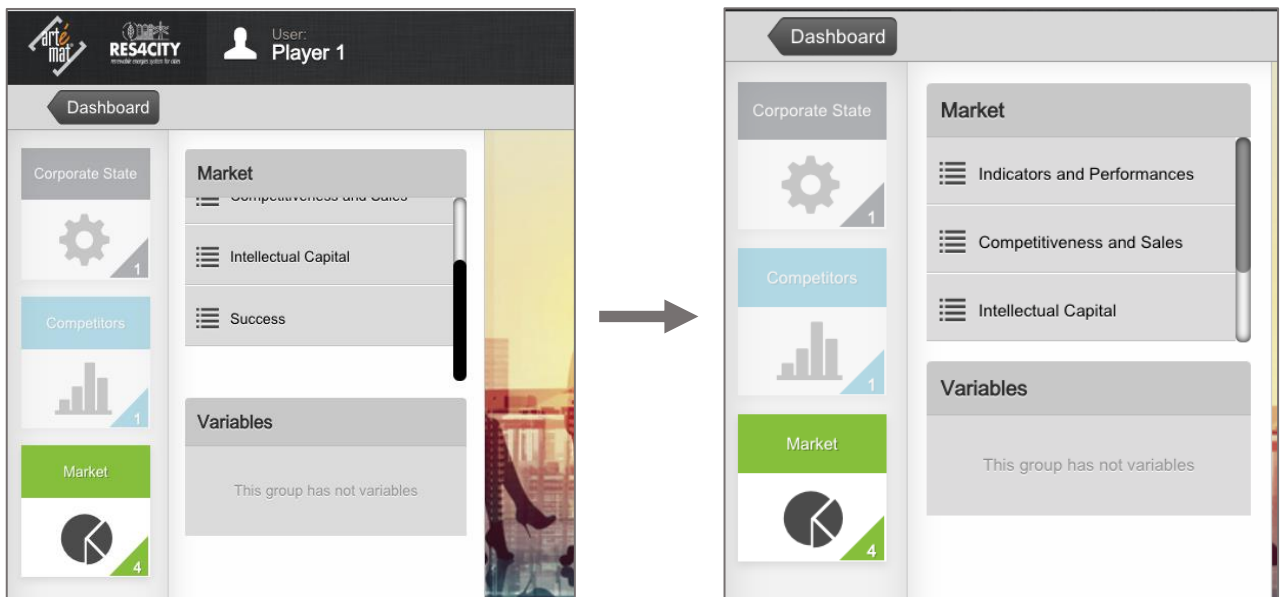


Figure 48. Screenshot – How to navigate the web interface/2

The “Competitors” box shows the economic reports (Income Statement, Balance Sheet and Cash Flow Statement).

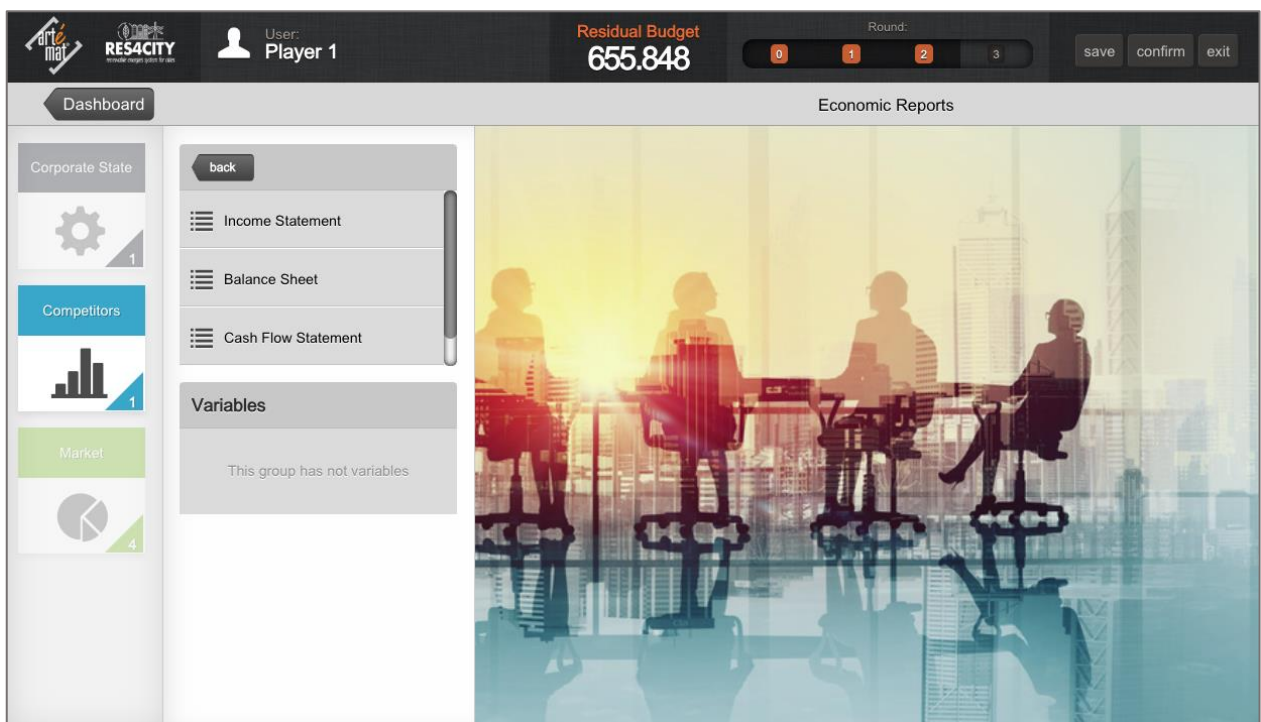


Figure 49. Screenshot – Economic Reports

The “Corporate State” box includes the “Production” (Annual production and Number of employees).



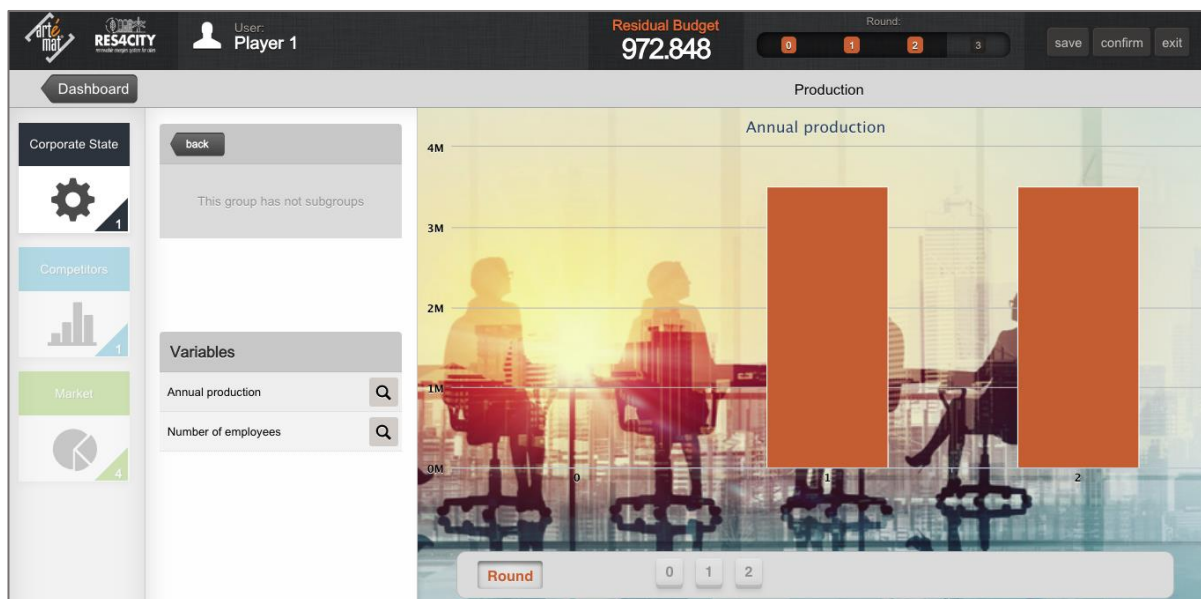


Figure 50. Screenshot – Production

### Technical Requirements

- The following browsers are supported: Google Chrome, Safari and Mozilla Firefox.
- For devices with a touch screen, it is necessary to use the latest version of Mozilla Firefox
- A session should not be left unused for a long time. In this case it is suggested to exit, saving the values chosen, and login again later.
- If the web connection goes down - even momentarily - the web interface of the game will continue displaying data, user can still make choices but the system will not save them. In this case, users should exit the session and login again with the same login details.
- If at some point during the game the 3 buttons "Save" "Confirm" and "Exit" on the top right-hand of the dashboard screen disappear - leaving only the 'exit' button - users need to refresh the page until the 3 buttons return.
- If the button "confirm" does not work with Google Chrome, it is necessary to switch to Mozilla.



### 3.2.12 Game Glossary (technical terms)

#### “Forecast” (Round 2 and 3):

*Residual Budget:* budget available.

*Investments:* training cost, advertising costs, big data analytics costs, packaging and waste reduction costs (only for round 2), renewable energy sources costs (only for round 2), research and innovation costs, employer branding costs (only for round 3), transportation efficiency costs (only for round 3) and energy efficiency costs (only for the round 3).

*Potential revenues:* annual production multiplied by the unit price during a round.

*Production:* number of pasta products (500 gr format) produced in each round (12 months). it can be increased in the third round on the basis of the value of the quality performance obtained in the second round. In particular, the production can increase by up to 10% of its previous value.

*Cost of production:* the sum of raw materials costs (increased by the choice on the product width) and energy costs.

*Total cost of personnel:* the sum of training costs, employees costs (only for round 3), sustainability manager costs and project manager costs (only for round 3).

*Potential cost of goods sold:* the sum of cost of production, total cost of personnel and overheads.

*Potential gross margin:* potential revenues minus potential cost of goods sold.

*Potential total commercial general and administrative cost:* the sum of transportation efficiency costs (only for round 3), logistic costs, selling costs, advertising costs, big data analytics costs, employer branding costs (only for round 3), research and innovation costs, packaging and waste reduction costs (only for round 2), renewable energy sources costs (only for round 2) and energy efficiency costs (only for round 3).

*Potential EBITDA:* potential gross margin minus potential total commercial general and administrative costs.

*Potential net income:* potential EBITDA minus taxes.

*Potential new energy consumption:* potential new energy consumption on the basis of the strategy implemented.

*Potential energy saving:* potential energy saving on the basis of the strategy implemented.

*Potential new carbon footprint:* potential new carbon footprint on the basis of the strategy implemented.

*Potential CO2 saving:* potential CO2 saving on the basis of the strategy implemented.

#### “Corporate State” Box (Round 2 and 3):

*Annual production:* number of pasta products (500 gr format) produced in each round (12 months). it can be increased in the third round on the basis of the value of the quality performance obtained in the second round. In particular, the production can increase by up to 10% of its previous value.

*Number of employees:* number of employees within the firm.

#### “Competitors” Box (Round 2 and 3):

Economic Reports->Income Statement-> Sales Revenues

*Revenues:* sales volume multiplied by the unit price during a round.

Economic Reports->Income Statement->Cost of Goods Sold

*Raw materials cost:* sales volume multiplied by the raw material unit cost.

*Energy cost:* energy price multiplied by the new energy consumption of the round.

*Production cost*: the sum of raw materials costs (increased by the choice of the product width) and energy cost.

*Employees cost*: number of employees multiplied by the employee unit cost.

*Sustainability Manager cost*: salary of the profile chosen.

*Project Manager cost*: salary of the profile chosen (only for round 3).

*Training cost*: cost of the training course chosen.

*Total personnel cost*: the sum of training costs, employee costs, sustainability manager costs and project manager costs (only for round 3).

*Overheads*: 10% on total personnel costs.

*Total cost of goods sold*: the sum of production cost, total personnel cost and overheads.

*Gross Margin*: revenues minus total cost of goods sold.

Economic Reports->Income Statement->Selling General and Administrative Costs

*Transportation efficiency cost*: cost of the option chosen (only for round 3).

*Logistic cost*: 10% on revenues. The transportation efficiency can decrease this value in the third round.

*Selling cost*: 5% on revenues.

*Advertising cost*: investments in advertising.

*Big data analytics cost*: investments in big data analytics.

*Employer branding cost*: cost of the option chosen (only for round 3).

*Research and innovation cost*: investments in research and innovation.

*Packaging and waste reduction cost*: cost of the option chosen (only for round 2).

*Renewable energy sources cost*: cost of the option chosen (only for round 2).

*Energy efficiency cost*: cost of the option chosen (only for round 3).

*Total commercial general and administrative costs*: the sum of transportation efficiency costs (only for round 3), logistic costs, selling costs, advertising costs, big data analytics costs, employer branding costs (only for round 3), research and innovation costs, packaging and waste reduction costs (only for round 2), renewable energy sources costs (only for round 2) and energy efficiency costs (only for round 3).

*EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization)*: gross margin minus total commercial general and administrative costs.

Economic Reports->Income Statement->Tax Expense

*Taxes*: 30% on EBITDA.

*Net Income*: EBITDA minus taxes.

Economic Reports->Balance Sheet->Assets

*Cash*: total net worth.

*Total Assets*: cash.

Economic Reports->Balance Sheet->Liabilities

*Capital Stock*: share capital of the firm (500.000 euros)

*Retained earnings*: net Income plus the retained earnings of the previous rounds.

*Total Net Worth*: capital stock plus retained earnings.

Economic Reports->Cash Flow Statement

*Taxes on EBITDA*: 30% on EBITDA.

*Free Cash Flow to the Firm*: EBITDA-taxes on EBITDA

**“Market” Box (Round 2 and 3):**

Indicators and Performances->Energy Consumption and Carbon footprint

*Energy consumption*: new energy consumption on the basis of the strategy implemented.

*Energy saving*: energy saving on the basis of the strategy implemented.

*Energy consumption performance*: performance calculated comparing the values of energy consumption of all the virtual firms in the market.

*Carbon footprint*: new carbon footprint on the basis of the strategy implemented.

*CO2 saving*: CO2 saving on the basis of the strategy implemented.

*Carbon footprint performance*: performance calculated comparing the values of carbon footprint of all the virtual firms in the market.

Indicators and Performances->Performances

*Quality Performance*: calculated on the basis of the strategy implemented (in particular, the set of strategic choices that determine the quality performance) and taking into account the starting value of “quality” of the firm chosen.

*Customer Satisfaction Performance*: calculated on the basis of the strategy implemented (in particular, the set of strategic choices that determine the customer satisfaction performance) and taking into account the starting value of “customer satisfaction” of the firm chosen.

*Sustainability Performance*: calculated on the basis of the strategy implemented (in particular, the set of strategic choices that determine the sustainability performance) and taking into account the starting value of “sustainability” of the firm chosen.

*Price Performance*: calculated on the basis of the price chosen.

Competitiveness and Sales->

*Competitiveness*: weighted sum of quality performance, customer satisfaction performance, sustainability performance and price performance.

*Prices on the market*: price.

*Demand*: overall demand on the market.

*Supply*: annual production.

*Potential sales volume*: potential sales volume on the basis of the competitiveness.

*Sales volume*: actual sales volume on the basis of the competitiveness and supply.

*Market share*: represents the sales volume as a percentage of the total market size (demand).

Intellectual Capital->

*Human capital index*: calculated on the basis of the strategy implemented (in particular, the set of strategic choices that determine the human capital index).

*Structural capital index*: calculated on the basis of the strategy implemented (in particular, the set of strategic choices that determine the structural capital index).

*Relational capital index*: calculated on the basis of the strategy implemented (in particular, the set of strategic choices that determine the relational capital index).

*Intellectual Capital Performance*: weighted sum of human capital index, structural capital index and relational capital index.

Success->

*Asset Value*: calculated on the basis of the free cash flow to the firm.

*Intangible Value*: calculated on the basis of the free cash flow to the firm and intellectual capital performance.

*Market Value*: the sum of asset value, intangible value and cash.

### 3.2.13 Hard and Soft Skills

#### RES4CITY Business Simulation Game – Single Player version

The simulation, in the single player version (1 human player and 4 virtual players), allows users to develop and boost a number of skills in an engaging and effective way. Below are some of the skills that a user may enhance through use of the simulation:

- **Analysis and Decision Making:** the user must assess and interpret the scenario, making strategic decisions based on various data sources. Starting by thoroughly understanding the rules and objectives of the business simulation game, users familiarize themselves with the game's mechanics, goals, and key performance indicators. Round by round, it is crucial to analyse the results obtained and compare them with the ones obtained by the competitors. The analysis is finalized in order to seek to increase the market value of the firm.
- **Critical Thinking and Problem Solving:** the simulation proposes complex challenges and scenarios that require creative problem-solving in order to analyse the context and develop a strategy. For this reason, users must think critically in evaluating various data sources and strategic options.
- **Flexibility and Adaptability:** round by round, the simulation introduces unexpected changes or market dynamics, and the user has to adapt and modify the strategy to new circumstances.
- **Marketing and Strategy:** the user leads their chosen firm, making decisions on the main strategic choices that characterize it – including marketing related choices. In particular, the focus is on improving customer satisfaction, taking in to consideration pricing policy, investments in advertising, training, big data and the product width. Every strategic choice is described in a detailed way, underlying its costs and benefits.
- **Economy and Finance:** the simulation requires users to make economic and financial decisions for his/her virtual firm. This includes managing budget, allocating resources, and making investment choices. Round by round, users can check and analyse the economic reports (Income Statement, Balance Sheet and Cash Flow Statement) and understand effects and impacts of the strategy chosen.
- **Sustainability:** users can understand the principles of sustainability by analysing different aspects, including: energy consumption, carbon footprint, features of raw materials suppliers, packaging and waste reduction, renewable energy sources, transportation efficiency and energy efficiency. All these elements are described in a detailed way, highlighting costs, benefits, strengths and weaknesses.

#### RES4CITY Business Simulation Game – Multiplayer version

In addition to the skills listed for the single player version, the multiplayer simulation (from 3 to 25 teams, meaning up to 150 users may participate in the same simulation) allows users to develop the following skills:

- **Collaboration and Communication:** users can test and improve their communication skills which represents a key component of collaboration. The team members must share information and opinions, discuss strategies, and consider alternative viewpoints.
- **Team Working and Team Building:** playing in teams, users have the opportunity to practice working collaboratively with others, learn how to coordinate efforts, delegate tasks, and leverage each user's strengths. Round by round, all the team members have a common objective to achieve.

### 3.3 Role Play Game

The Role Play Game (RPG) is a single player tool that simulates a specific and realistic scenario where the user is called upon to make decisions, organize work, assign priorities, delegate, manage information and solve critical issues. Users play the role of the main character in the simulation: this role-play element enhances the immersive experience and encourages users to make decisions and take actions based on limited information within predetermined timeframes.

The Role-Play Simulation (RSP) described here is a powerful and immersive approach for skill assessment and development (communication, collaboration, negotiation, problem-solving, stress management, etc.). This method leverages a dedicated web platform and various simulation models/scenarios to create realistic application contexts. RSP requires active engagement from users, encouraging them to apply and test both hard and soft skills. Users are placed in situations that demand skills, including communication, collaboration, negotiation, problem-solving, stress management, and decision making based on limited information and within predetermined timeframes. This aspect adds an element of realism and urgency to the simulation, mimicking real-world scenarios. The dedicated web platform provides easy and convenient access for users. They can participate in simulations from various devices with internet connectivity, including PCs and mobile devices. The platform's engine can handle different simulation models and scenarios. Each simulation model is designed to replicate a specific application context. This context could represent the responsibilities and challenges of roles like a manager, industry specialist, or other professional position. The simulations create environments that closely resemble real-world situations.

#### 3.3.1 Technology

The Role Play Game simulation scenarios have been developed using Artémat's proprietary web-based platform "Web InBasket", designed and built with a mobile-responsive layout for diversified accessibility (smartphones, tablets, and desktops). The use of the web-based platform "Web InBasket" for Role-Play Game (RPG) simulations offers several advantages and benefits. Here are some key points highlighting the advantages of this platform:

- **Diverse accessibility:** The platform is designed with a mobile-responsive layout, making it accessible on a wide range of devices, including smartphones, tablets, and desktop computers. This ensures that users can participate in RPG simulations using the device of their choice, providing flexibility and convenience.
- **No software installation:** Users are not required to install any proprietary software or applications to access and use the platform. They can simply use a standard web browser, which is widely available on most devices. This eliminates the need for complex installation processes and reduces potential compatibility issues.
- **Easy maintenance:** Web applications are more easily maintainable compared to desktop or mobile applications. Updates and enhancements can be centrally managed and applied, ensuring that all users have access to the latest features and improvements. This streamlines the maintenance process and ensures consistency.
- **Platform agnosticism:** The web-based platform is not limited to specific operating systems (e.g., iOS, Android, Windows, Linux). Users can access and use the platform from any operating system with internet connectivity. This inclusivity promotes accessibility and user participation.

- **Uniform user experience:** Regardless of the device or operating system used, users will experience a consistent and uniform interface and set of functions. This consistency ensures that all participants have a similar experience and can easily adapt to the platform, regardless of their device.
- **Scalability:** Web applications can be easily scaled to accommodate a growing user base. This makes it suitable for a wide range of scenarios, from small-scale simulations to larger-scale educational or corporate training programs.
- **Reduced hardware dependency:** Since the platform is web-based, users are not reliant on specific hardware specifications. They can access the platform from devices with varying hardware capabilities, making it accessible to a broader audience.
- **Security and data management:** Web applications can incorporate robust security measures and data management practices to protect user information and ensure the privacy of participants. This is crucial, especially in scenarios involving sensitive data or confidential information.

The Web InBasket platform has a structure based on multiple layers: a presentation layer, a business layer, and a persistence layer. This separation allows easy and independently development and updates for each layer, providing scalability and maintainability of the application.

- The persistence layer is based on a relational database responsible for storing information and ensuring its integrity.
- The business layer handles simulation logic, user management, and authentication processes.
- The presentation layer is responsible for displaying information and is further divided into two main modules: the administrator interface and the user interface, which are accessed after an authentication process. These two modules are entirely independent and communicate with the business layer through a series of asynchronous REST calls.

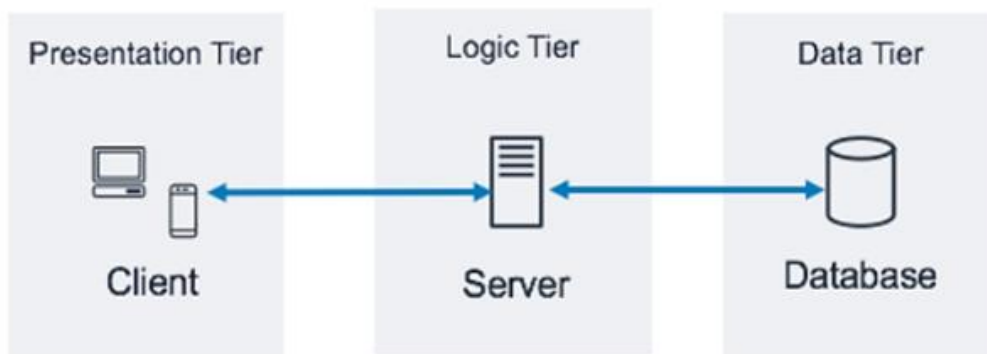


Figure 51. Web InBasket platform

The Web InBasket platform includes an administrator interface that allows for the following actions:

- **Creation and Configuration of New Simulation Campaigns:** A campaign is a container for users who are authorized to run one or more simulations of a given model. A campaign has the following properties:
  - An ID for identification.
  - A name.
  - Start and end dates.

- A simulation model.
- A collection of users.
- Ability to add a Collection of Users to a Campaign
- Real-Time Summary Report Display on the Status of Simulations for Each User: Additionally, for each user, it's possible to view and download reports at the end of the simulation.

The User Interface implements the display and control logic of the simulation as defined in the model. The simulation logic is organized as a hierarchical finite-state automaton. A finite-state automaton is a mathematical model composed of a finite set of states, a set of transitions between states, and a collection of rules that determine how to transition from the current state to the next state based on user inputs. Transitions from one state to another are triggered either by the user or by internal logic within the model organized based on time. After a registration and authentication phase, the user accesses various phases/states of the simulation as shown in the next figure.

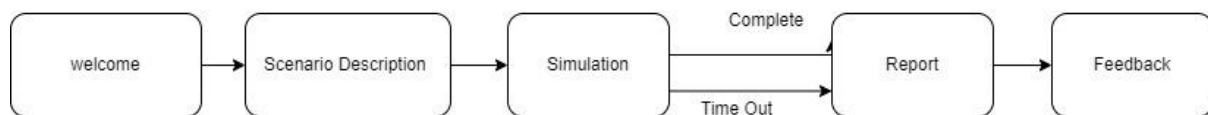


Figure 52. Simulation Automata Scheme

### 3.3.2 Simulation structure

The simulation is structured into different “states”:

#### Welcome

In the Welcome state, the platform allows the user to:

- View a welcome message with a brief description of the simulation.
- Choose an avatar for the simulation (name, gender, photo). Based on this choice, the platform acquires user-provided information and contextualizes it for all subsequent steps.
- Transition to the next state, "Scenario description."

#### Scenario Description

In the Scenario Description state, the platform provides the user with the following information:

- A description of the simulation context using multimedia content (text, images, video).
- The role the user plays.
- The objectives to be achieved.
- The characters (roles and responsibilities) with whom the user interacts during the simulation.
- A description of how the platform works and its rules.

#### Simulation

A "Start" button allows the user to start the simulation and the countdown. The simulation is composed of a set of events: the user can freely navigate and interact with different tools ("Chat", "Email", "Documents", "Report") in order to complete each event. Additionally, users can access slides that describe the simulation scenario and characters. The user completes the simulation until the final event and respecting the duration of the simulation. At the end of the simulation, the simulator generates a report based on a mathematical model.



## Chapters

A simulation, as a whole, is a list of events organized into chapters. To enhance the narrative experience, the simulation is logically organized into different chapters.

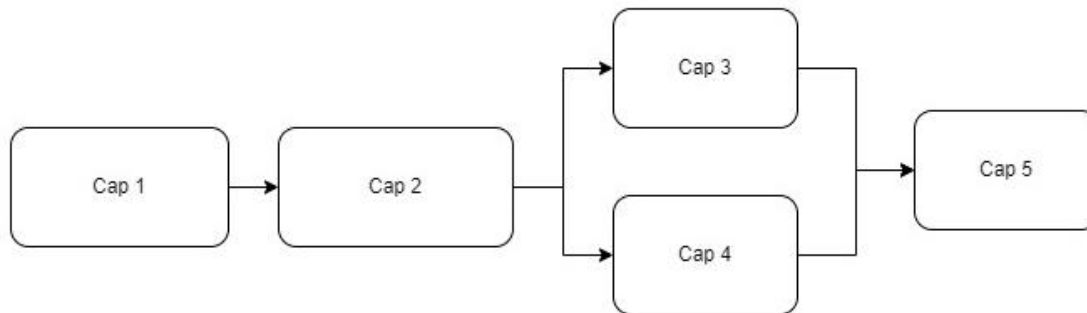


Figure 53. Chapters scheme

The use of "Chapters" in a simulation scenario provides a structured and engaging approach to training or evaluation. Each chapter introduces a new context or set of challenges, offering several advantages:

1. **Diverse situations and environments:** By dividing the simulation into chapters, users are exposed to different situations and problems. This diversity ensures that they operate in various environments and interact with different actors, which broadens their experience.
2. **Sustaining user engagement:** Each chapter acts as a distinct segment of the simulation. This structure captures the user's attention and encourages their continued engagement. Users are motivated to progress through the simulation, one chapter at a time, as they work to address specific issues.
3. **Plot development:** The use of chapters allows for the management of plot developments. This can create a narrative structure that keeps users invested in the simulation, as they follow the progression of the story or scenario.

The structure of each simulation chapter typically includes:

- **Introductory event:** This event serves as an introduction to the new context or scenario. It sets the stage for the challenges that users will face in the chapter.
- **Events and problems:** A list of events or problems is presented to users within the chapter. These events describe the specific challenges or issues they must address.
- **Decision points:** Users are presented with decision points throughout the chapter, allowing them to make choices that affect the outcome. These decisions are aimed at resolving the various problems introduced in the chapter.
- **Concluding event with feedback:** At the end of each chapter, an optional concluding event provides feedback to the user. This feedback can highlight the consequences of their decisions and actions within the chapter, helping them learn and improve.

The structured approach of using chapters in a simulation scenario not only enhances the user experience but also facilitates learning and skill development. It allows for a more immersive and narrative-driven simulation that keeps participants engaged and motivated to progress through each segment of the experience.

The image below shows the structure of a simulation scenario.

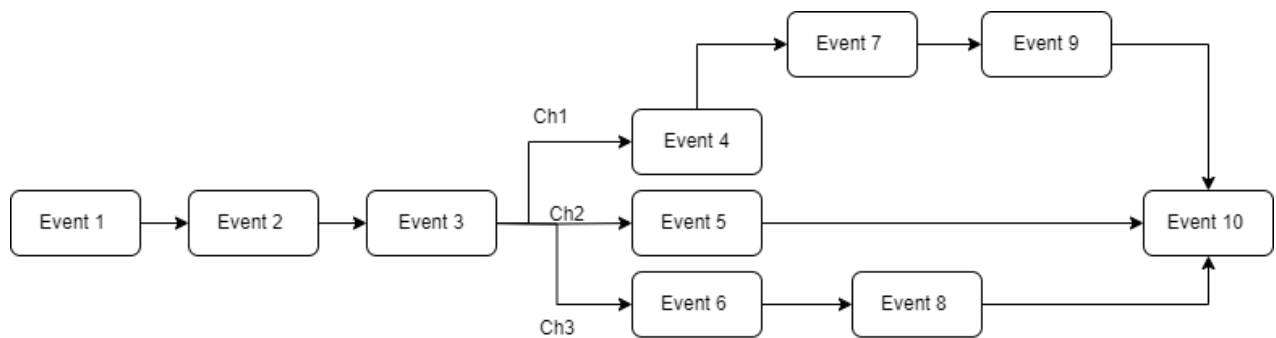


Figure 54. Event graph scheme

The event graph scheme in figure (example with 10 events) includes a starting node called "Event 1," an ending node "Event 10", a collection of intermediate nodes, and a collection of relationships (edges) between different nodes (events).

### Events

From a purely technical standpoint, the part of the model related to simulation events is structured as an acyclic directed graph where nodes represent individual events in the scenario, and the edges represent the transition relationships from one node to another. Mathematically, this is an acyclic graph. Acyclicity is guaranteed by construction because each event is presented to the user only once during the entire simulation. Analyzing the figure 54, it is possible to observe:

- An initial node representing the start of the simulation.
- A final node representing the end, with a collection of intermediate nodes that have a branching structure.
- A collection of edges that map the relationships between the events. These relationships determine the narrative's progression.

Furthermore, by analysing the previous figure, you can see that there are nodes with a single outgoing edge and nodes with multiple outgoing edges, with annotations indicating blocking events that require mandatory user interaction.

An event, as a whole, is the individual entity of the simulation and comprises:

- A tool with which it should be experienced (e.g., email client, messaging system, calendars, documents, reports, etc.).
- An actor within the scenario with whom the user must interact.
- The content (email text, chat message text, content of individual documents, structure of a report to be completed, dialogue text).
- A list of rules that determine the subsequent event.

Events can be of two main types:

- Standard events: Events whose purpose is to describe the issue from the perspective of the proposing actor. Typically, their evolution is based on a temporal basis.
- Events with decision points: These are moments when the simulation actors ask the user to make a decision from the proposed options. In this case, the event includes two or more possible alternatives from which the user must make a choice.

In the example shown in figure 54, Event 3 presents three possible choices: ch1, ch2, ch3. Depending on the choice made, the simulation engine determines the next event. Consequently, users who make different decisions experience a different sequence of events, leading to a different storyline. Each user's simulation is represented by a path on the graph, starting with the initial node "Event 1" and ending with the final node "Event 10." During the design phase, it is advisable for all paths to have a similar number of decision points to achieve a well-balanced model.

### Report

After completing the simulation, the platform shows the "Report" stat to the user, performing a series of internal procedures to calculate the scores and indicators necessary to construct the overall simulation report. The report is based on the decisions made by the user and the path taken. For each decision point in the modeling phase, scores are defined for each individual choice:

- A score affecting the overall calculation of an individual skill.
- A score impacting the final evaluation of the test.

Scores for each individual choice can be positive, negative, or neutral. A formula defined in the design phase is used to calculate the overall scores for each individual skill. The report consists of several elements that can be activated and customized based on the model:

- An overall score and its description.
- A chart showing the overall scores obtained in various skills.
- A description for each skill based on the score.

The platform also allows the user to export the report obtained in PDF format.

### Feedback

Following the report phase, the platform shows the "Feedback" state, where the user is asked to complete a questionnaire consisting of closed-ended and open-ended questions. The questionnaire is useful for:

- Evaluating how well the events in the model engaged the participants.
- Collecting suggestions from the players on how to improve the events of the model and the tools in the platform.
- Enhancing and optimizing the design of new models.

Upon completing the feedback, the platform concludes the simulation and directs the user to a link defined in the model.

### 3.3.3 Simulation scenario design

Designing a simulation scenario for the Role Play Game, based on Web inBasket platform, covers the following aspects:

- Simulation Objectives:
  - Analysis of skills (soft or hard): Typically based on a skill map to investigate (e.g., problem-solving, leadership, collaboration, communication, analytical skills, resilience, etc.). In this case, the end result is the construction of a report mapping the skills.
  - Training: Based on specialized topics that can be acquired through simulation. In this case, the simulation system not only delivers educational content through innovative and effective methods but also creates an automatic system for advancing the level of learning.
- Simulation target: It is essential to define the target/population (e.g., recent graduates, managers, technicians, etc.) to contextualize the simulation environment (the set of situations and language to be developed).
- Scenario definition through storytelling: Storytelling is the key to activating several positive factors in users:
  - Emotional engagement: Stories are inherently engaging and can evoke emotions, capturing users' attention and involving them more in the learning or assessment process.

- Memorization: Users tend to remember information better when presented in a narrative form. Stories create a context that helps users connect information more effectively and recall it later.
- Contextualization: Storytelling can help contextualize the concepts and skills to teach or assess. Stories provide real-life examples of situations where these skills are important, allowing users to see how to apply them in practice.
- Experiential learning: Simulations offer experiential learning, where users learn by doing. Stories can be incorporated into simulations to add a narrative element that makes the experience more engaging and meaningful.
- Identification and empathy: Stories can present characters with whom users can identify. This can increase empathy and understanding of different perspectives and situations.
- Problem solving: Stories can be used to present complex situations or business problem scenarios. Users can be challenged to solve these problems using the skills they are learning or demonstrating the required skills for recruitment.
- Simulation dynamics definition: In simulation dynamics, it is crucial to develop engaging and immersive storytelling structured over various timelines based on user decisions. This keeps the user's interest constantly alive. To achieve this, it's advantageous to:
  - Describe individual actors and their roles in the story's plot.
  - Identify one or more missions that require the user to complete a series of tasks to achieve a final goal.
  - Create a collection of situations/events to present to the user that describe the issues on which they need to make decisions.
  - Create a collection of exercises, challenges, or tasks of varying complexity, identified as decision points, that the user must complete within the simulation context. For each decision point, it's necessary to define the various possible options that the user can activate. Scoring for the choices made is also necessary to determine the final outcome for each skill.
- Simulation scenario testing: Tester feedback can guide adjustments in the scenario to make it more effective. These adjustments may include changes in the plot, character dialogues, or descriptions. During testing, it's also possible to review and optimize assessment metrics to ensure they accurately reflect participant behavior and simulation objectives.
- Final report/feedback: A final report/feedback (calculated on the basis of specific criteria) is provided to the user. Feedback is important for different reasons, whether in learning and training contexts or in areas like work and performance assessment. It offers clear information on what has been done well or poorly, helping users develop their skills and abilities. It also helps ensure that organizational expectations are clear, and individuals work toward common or specific goals.

### 3.3.4 Simulation Scenario Overview: “Fabian Energy Community Game”

The Fabian Energy Community Game is a role-playing game that simulates a specific business scenario associated with renewable energies and fuel technologies. Playing the role of the main character, user must make decisions, organise work, manage information and solve problems related to sustainability, the circular economy and renewable energy. The goal is to engage users with different backgrounds in adopting more sustainable energy behaviors. The model is structured with a scoring system that rewards the completion of activities related to renewable energy, such as the installation of solar panels, energy efficiency, and consequently, consumption reduction, taking into consideration the economic impact.

Fabian Energy Community Game has been designed and developed to be presented and played in the Sustainable Energy Week, held on June 2023 in Bruxelles.

### 3.3.5 Features of “Fabian Energy Community Game”

#### Login page and introduction

User plays the role of a new Energy Manager in a fictitious community known as the “Fabian Energy Community”. The community has set ambitious goals for decarbonizing its energy consumption. The “Fabian Energy Community” is composed of: two condominiums (Red and White), a school, a shopping centre and a leisure centre. Each of them has different electricity consumption and heating demands. Together with the colleague (Matilde or Steve), users are asked to make decisions and solve problems based on an analysis of energy audit reports and the interaction with community members. The objective is to develop and implement a comprehensive energy plan that includes specific goals and targets for reducing energy consumption and increasing the use of renewable energy.

Figure 55. Screenshot - Login page



Figure 56. Screenshot - Introduction

**Avatar choice and other characters**

The platform offers the option to choose an avatar, Matilde or Steve. Let's assume the choice is Matilde: from this point onward, the simulator will tailor the scenario in the “female form”, with Matilde as the main character and Steve as her colleague. The storyboard includes also other characters.

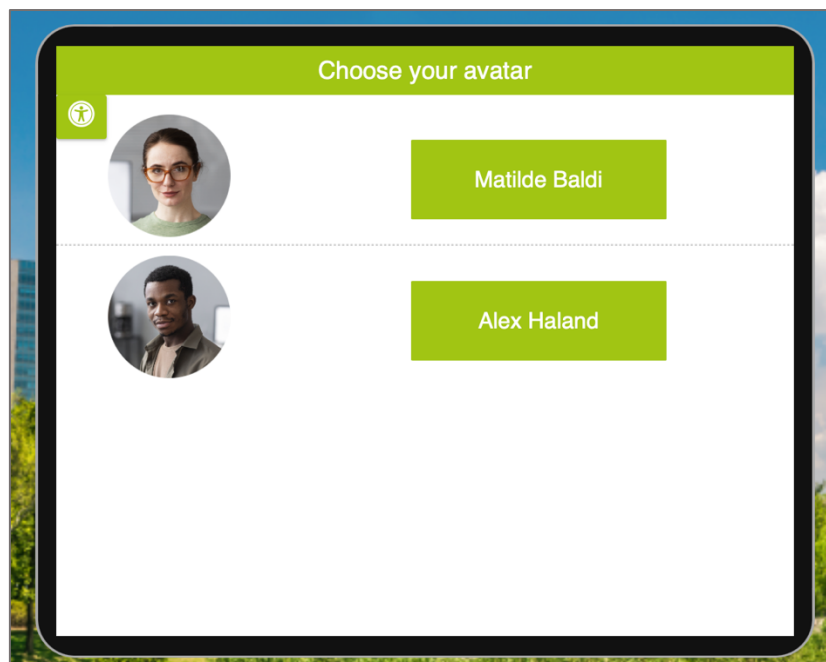


Figure 57. Screenshot - "Choose your avatar"

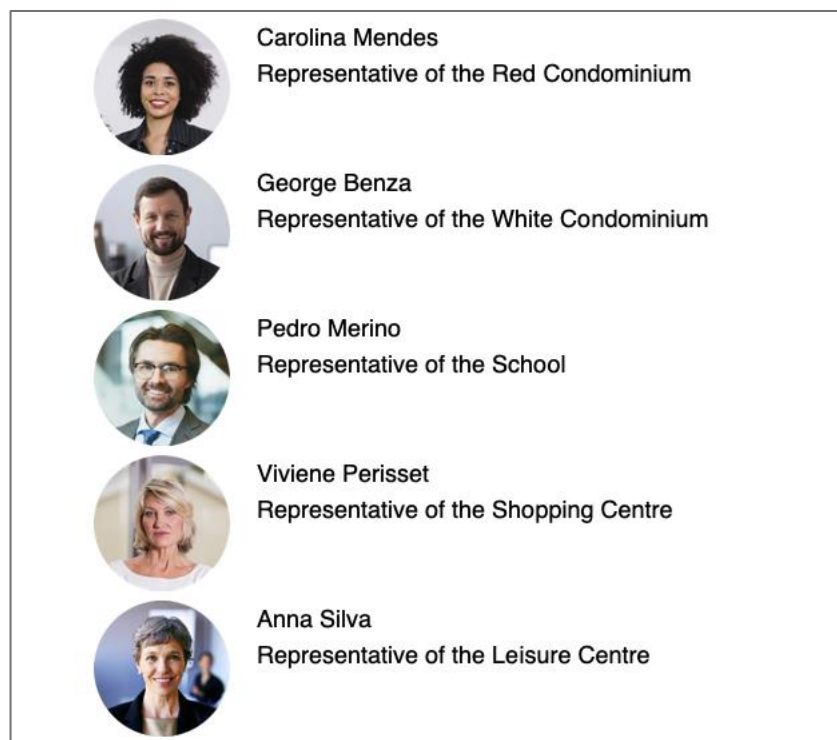


Figure 58. Screenshot - other characters

### 3.3.6 Hard and Soft Skills

The simulation allows users to develop and enhance a range of skills in an engaging and effective way. Below are some of the skills that users can enhance through the simulation:

- **Communication:** users must interact with his/her virtual colleague and with the other characters in order to develop an energy plan and achieve a number of objectives. In doing so, a number of skills may be enhanced, including negotiation skills, conflict resolution skills, communication skills, an ability to find common solutions, managing differences, and reaching agreements. These skills are evaluated through the events scoring.
- **Results Orientation:** the user's ability to identify priorities and objectives and make ongoing choices aimed at achieving them. This skill is evaluated through the events scoring.
- **Cooperation and synergies:** the user's abilities to collaborate, share and cooperate with his/her virtual colleague and the other characters in order to achieve a common objective.
- **Knowledge:** the user's knowledge in the field of renewable energy and sustainability. This skill is evaluated through the events scoring and the test (four questions).
- **Energy Analysis:** the user's ability to analyze energy data (energy audit) and assess the implementation of energy efficiency measures aimed at optimizing energy use in buildings, including improving insulation systems, heating, cooling, and renewable energy production systems. This skill is evaluated through the energy plan development.

### 3.3.7 Simulation Storyboard

Below is a sequence of the main events (screenshots) of the storyboard.

**Starting event** and example of answer evaluation (scoring):



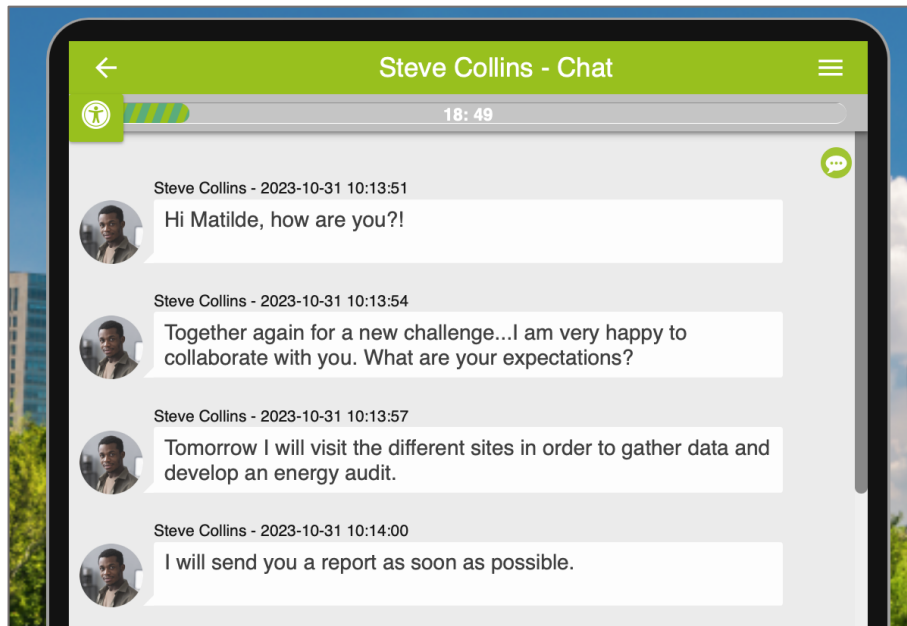


Figure 59. Screenshot - starting event (chat tool)

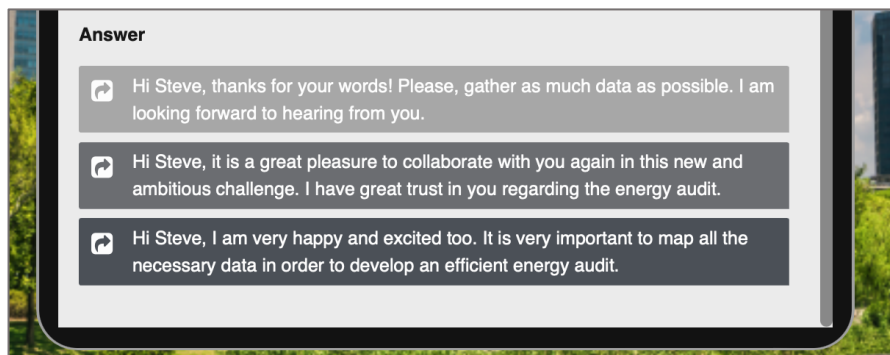


Figure 60. Screenshot - starting event (answer)

Based on the answer chosen, the simulator assigns a **score** (for all events):

Choice	Skills				
	Results Orientation	Communication	Cooperation and synergies	Knowledge	Energy Analysis
Hi Steve, thanks for ...	-1	-1	-1	0	0
Hi Steve, it is a great ...	0	1	1	0	0
Hi Steve, I am very ...	1	0	0	0	0

**Test tool:** the test is composed of four questions and multiple choice answer (only one is correct). If the user selects the correct answer, one point is added to the “Knowledge” skill score.

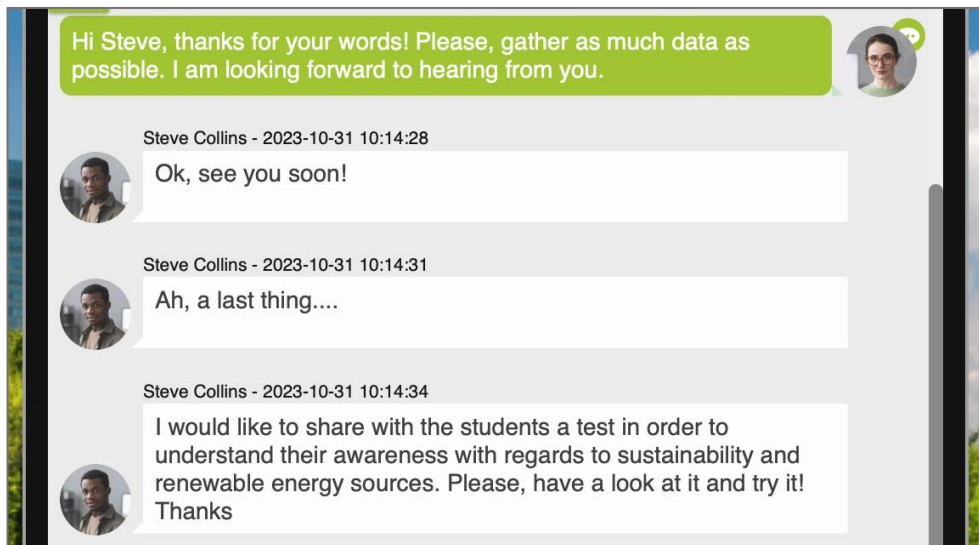


Figure 61. Screenshot - answer selected and subsequent chat

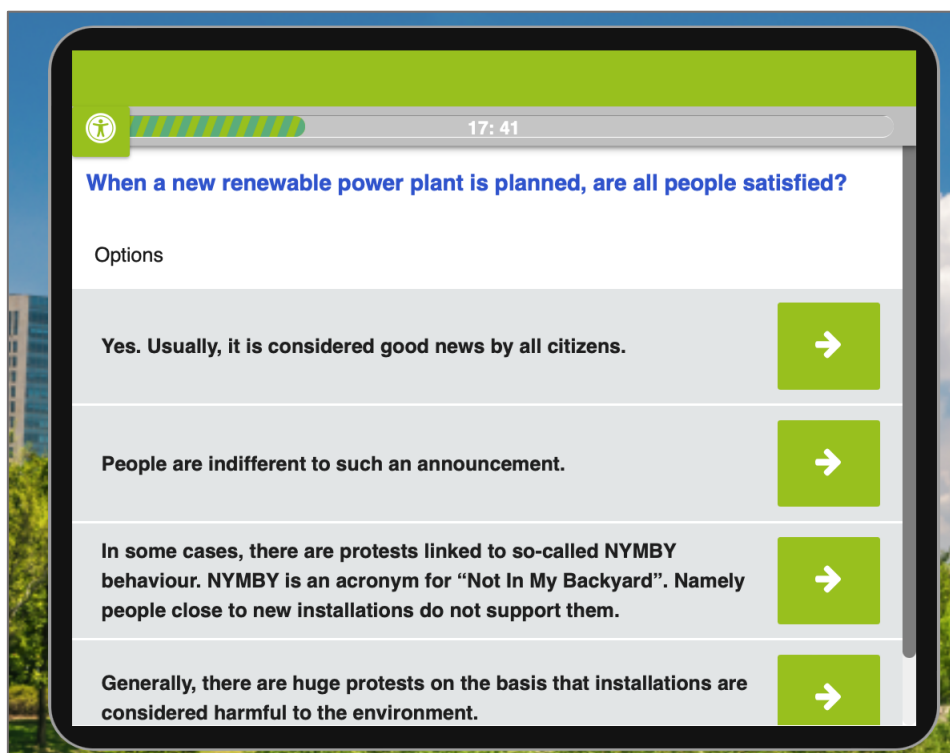


Figure 62. Screenshot - Test (question and answers)

Events on “carbon emission” calculation:

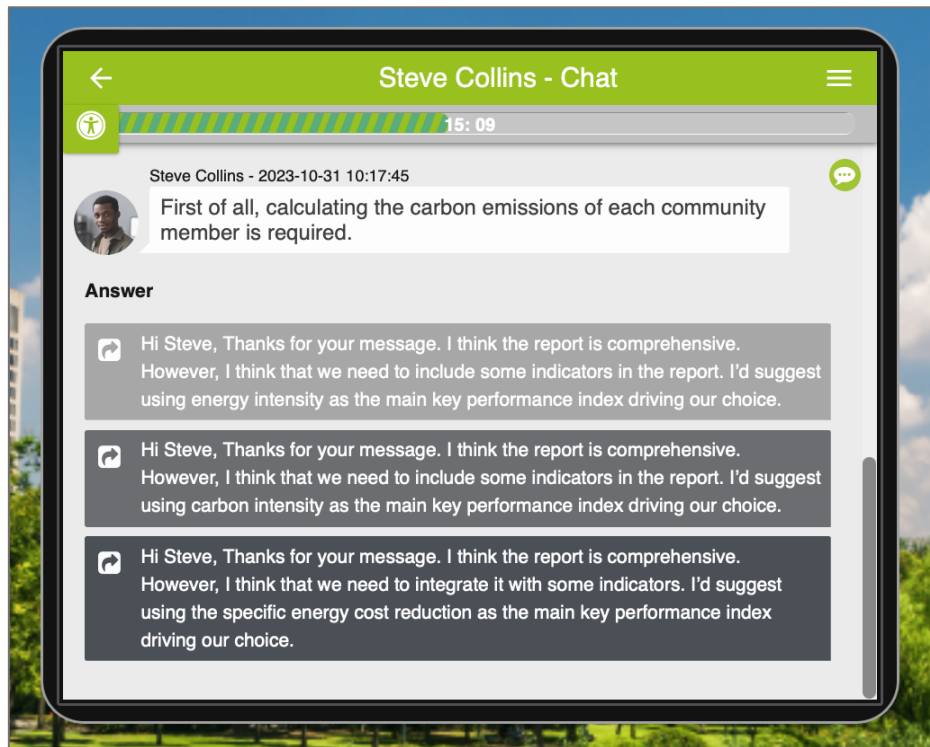


Figure 63. Screenshot - "carbon emission" (chat)

**Energy plan:** users must develop an energy plan, starting from the analysis of a report (energy audit) and from an available budget of 1.716 euros. Per each building (condominiums Red and White, school, shopping centre and leisure centre) the user must choose the area (percentage) covered by solar panels and the energy efficiency retrofiting. Each choice has costs and benefits.

In particular, the simulator calculates the following parameters on the basis of each choice:

- Allocated budget.
- Residual budget.
- Energy savings.
- Cost savings.
- Emission savings.

And per each building:

- Total Cost.
- Overall Energy savings.
- Overall cost savings.
- Overall emission savings.

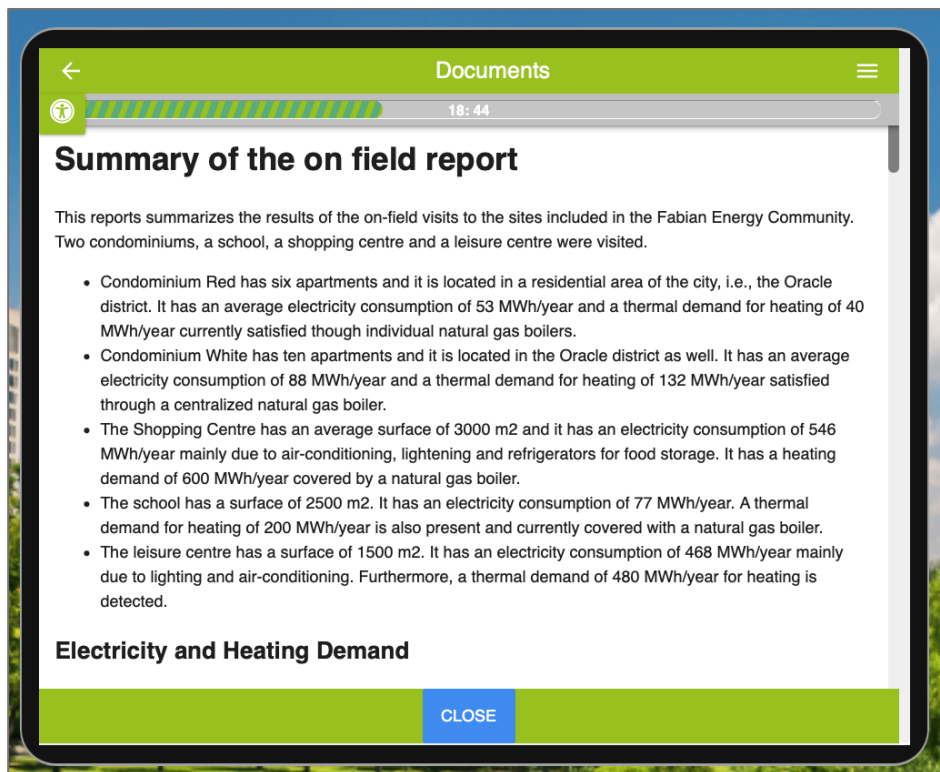


Figure 64. Screenshot – Energy audit report/1

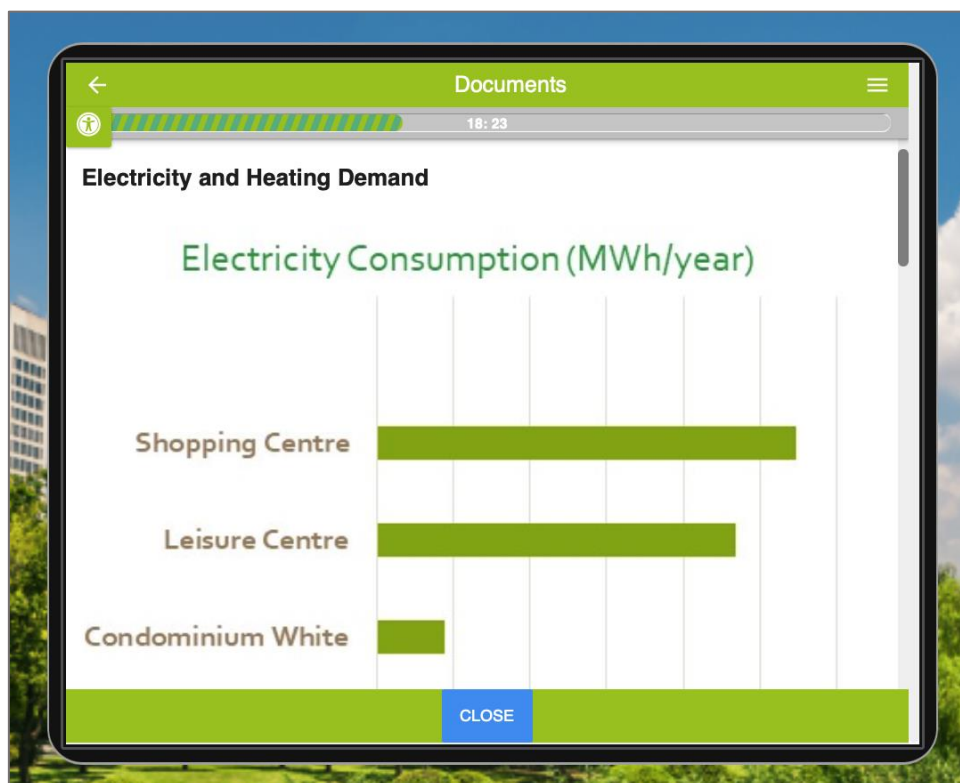


Figure 65. Screenshot – Energy audit report/2

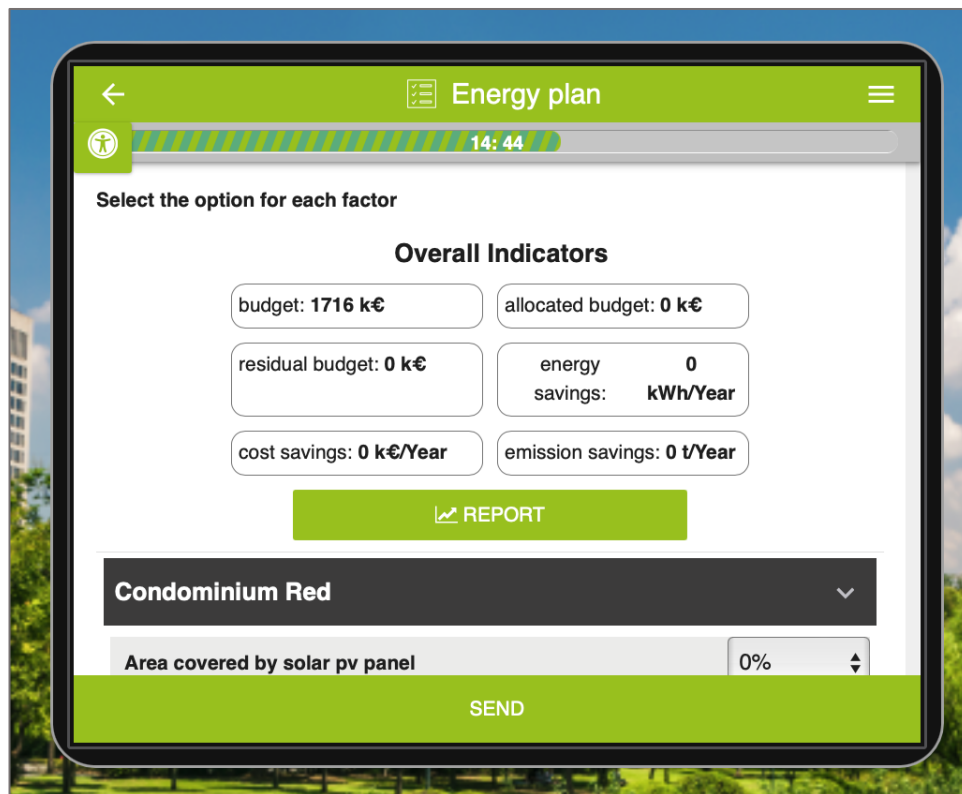


Figure 66. Screenshot - Energy plan/1

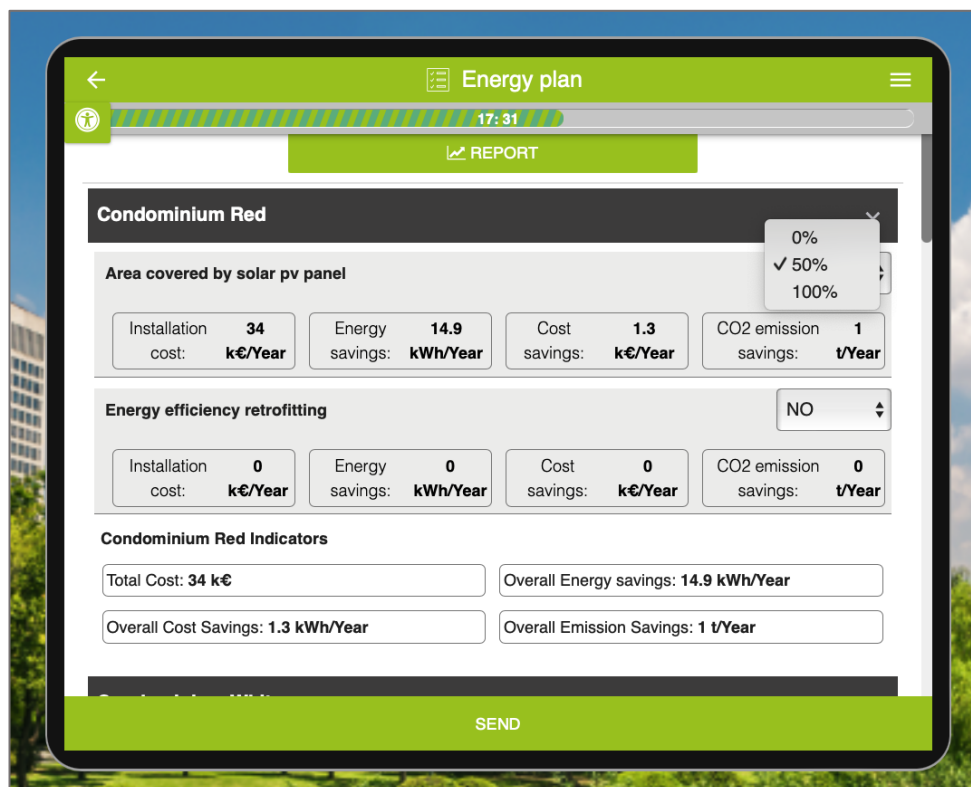


Figure 67. Screenshot - Energy plan/2

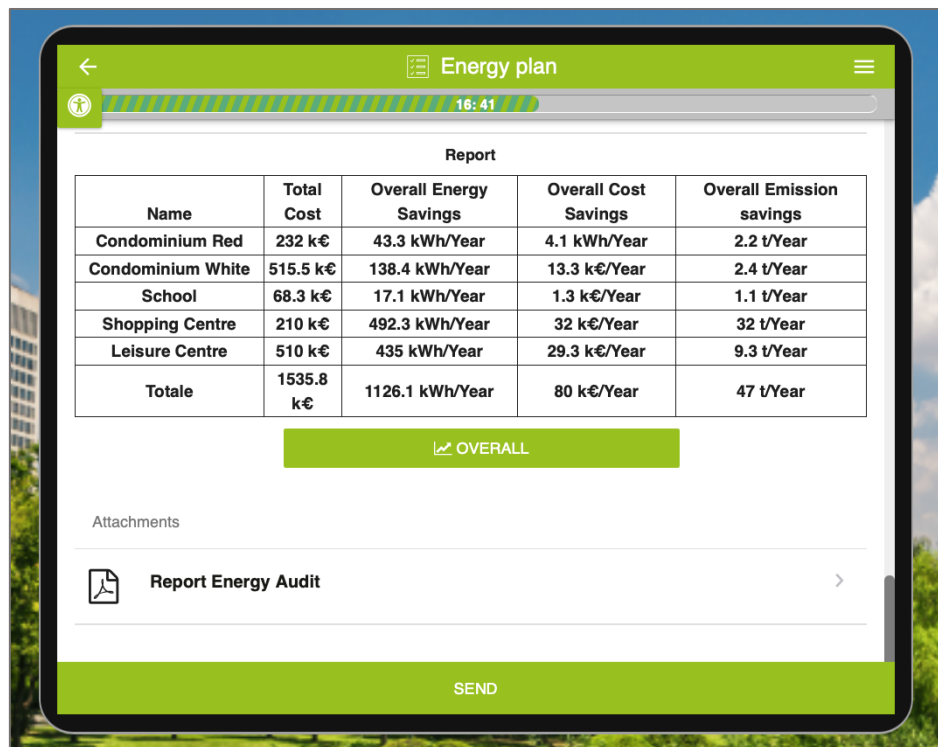


Figure 68. Screenshot - Energy plan/3

Meeting with stakeholders:

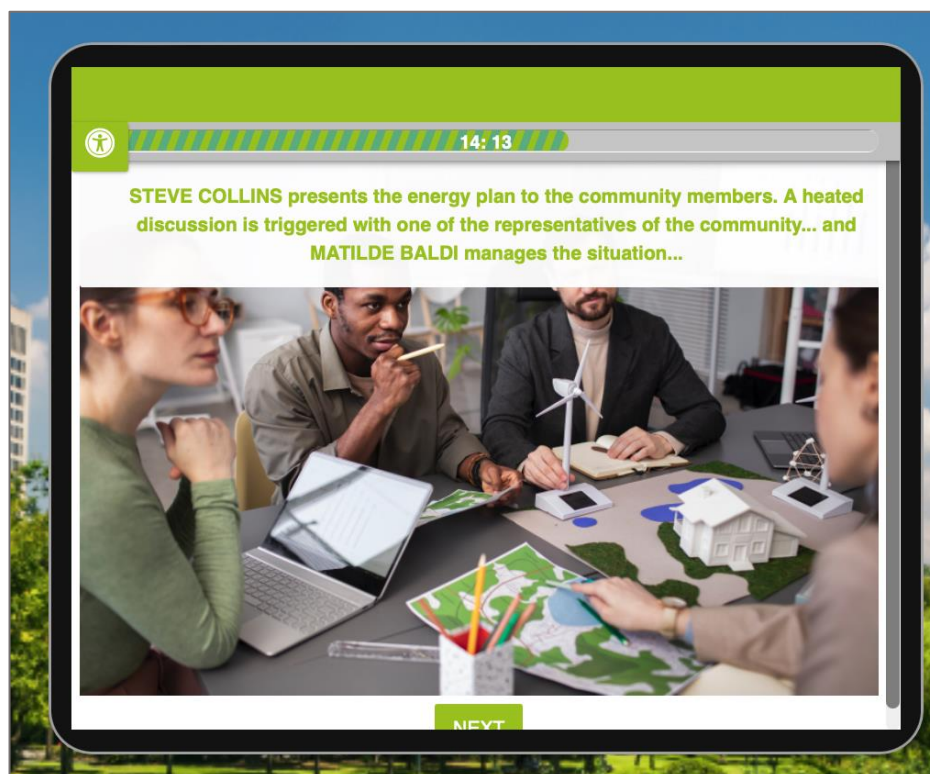




Figure 69. Screenshot – Meeting/1

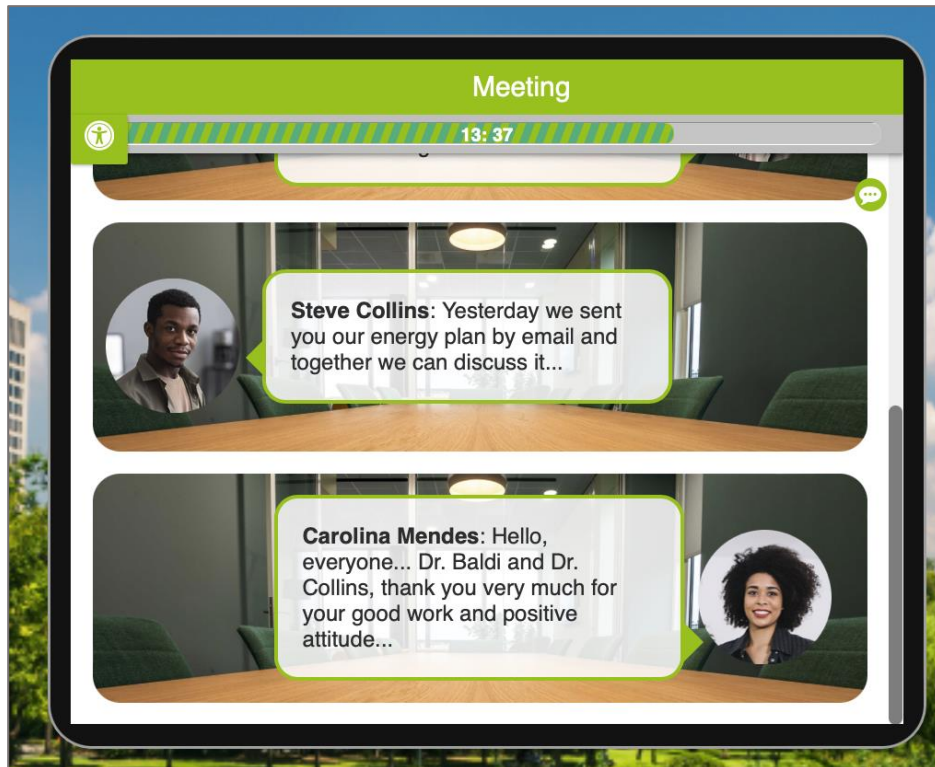


Figure 70. Screenshot – Meeting/2

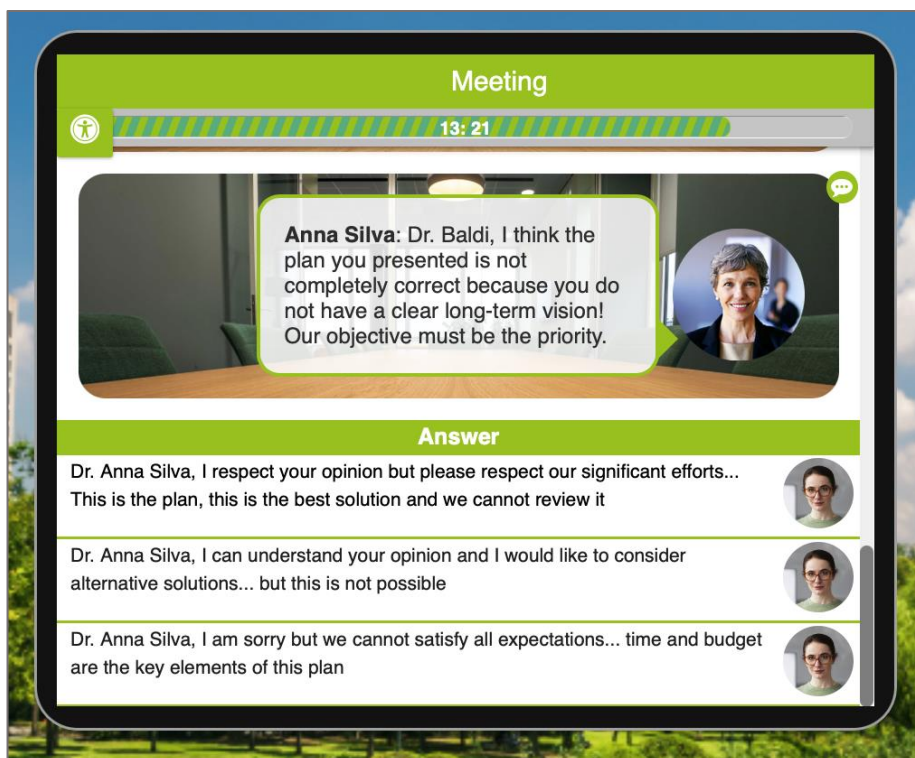


Figure 71. Screenshot – Meeting/3



**Final event:**

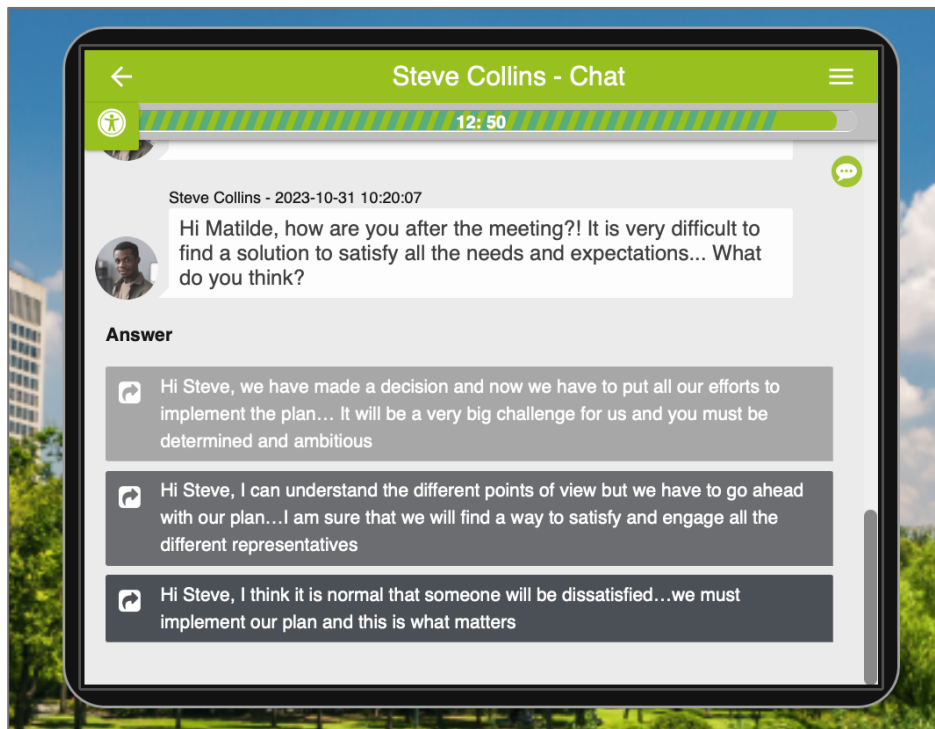


Figure 72. Screenshot – Final event

**3.3.8 Report**

After completing the simulation, the simulator guides the user to the report page, where it is possible to view the results obtained and download the Report file in PDF. The simulator calculates the score for each skill using the following formula:

$$scoreSkill_i = \sum_{k \in eventUserChoices} score_i(k) \forall i \in skillSet$$

where:

- *SkillSet*: is the following set of skills: Communication, Results Orientation, Cooperation and synergies, Knowledge, Energy Analysis.
- *EventUserChoices*: is the set of choices made by the user during the simulation.
- *Score*: is the score associated with choice “k” on skill “i”. This score can be defined directly in the design phase or calculated using a formula defined in the model during the scoring phase.
- *ScoreSkill*: is the overall score per each skill.



Figure 73. Screenshot - Report

The simulator also calculates an overall score ( $scoreTot$ ) for the overall simulation using this formula:

$$scoreTot = \sum_k^{k \in skillSet} scoreSkill_k$$

Based on the calculated score, the final report is composed of three sections:

- The first section includes information about the overall simulation.
- The second section describes the skills: a radar chart shows the score for per each skill, rescaled on a scale from 0 to 5.
- The third section includes an automatic evaluation: the simulator generates a qualitative text on the basis of the hard and soft skills score obtained at the end of the simulation.

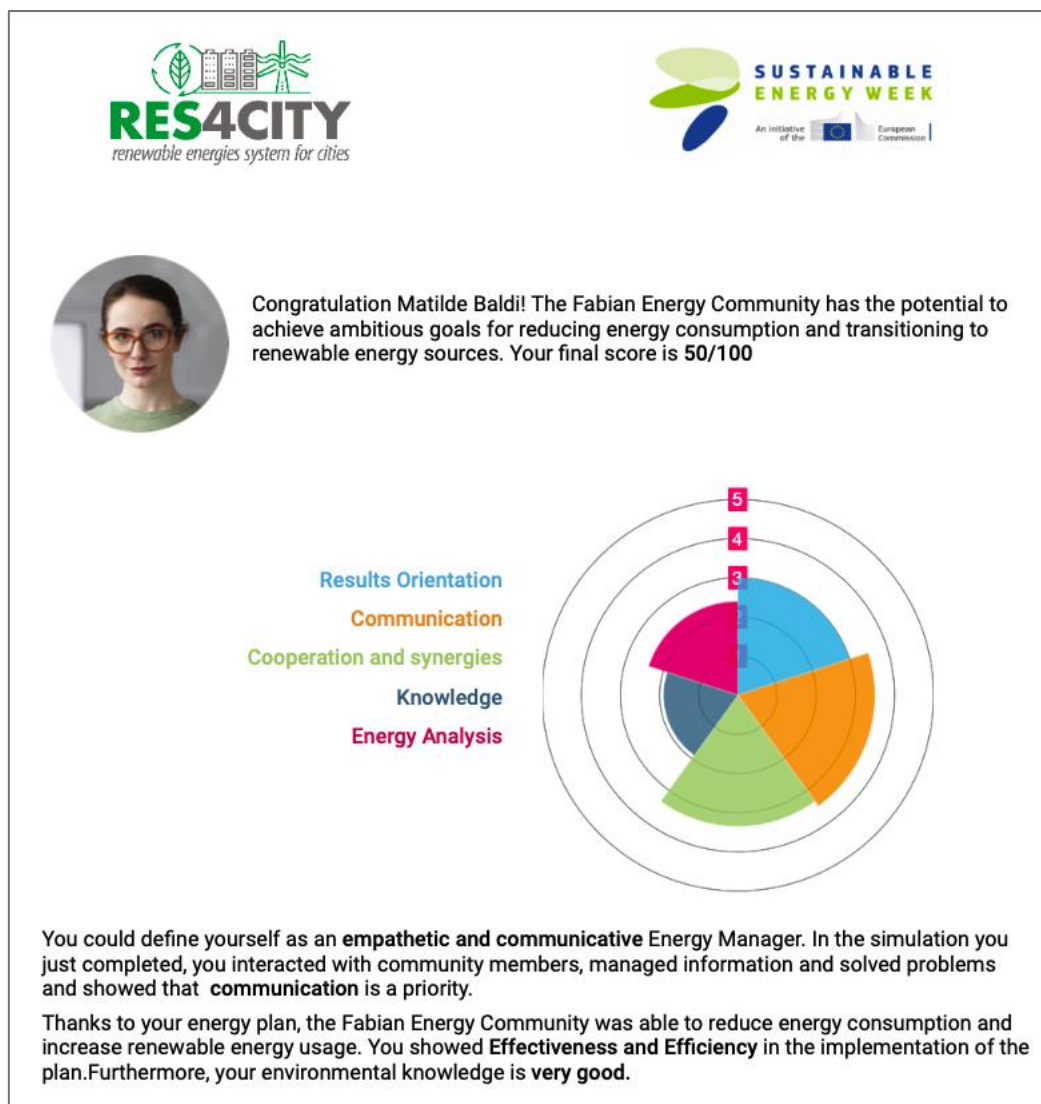
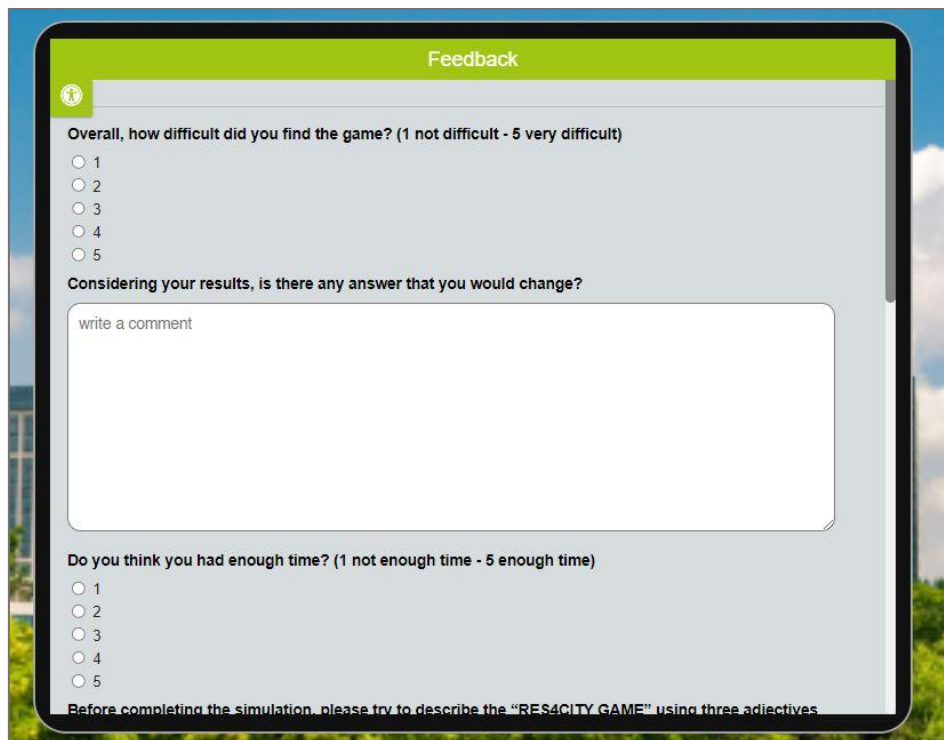


Figure 74. Report

### 3.3.9 User feedback

The user can fill in a feedback form after viewing the report page. The form is composed of the following questions:

- Overall, how difficult did you find the game? (1 not difficult - 5 very difficult)
- Considering your results, is there any answer that you would change?
- Do you think you had enough time? (1 not enough time - 5 enough time)
- Before completing the simulation, please try to describe the “RES4CITY GAME” using three adjectives.
- Is the game scenario relevant for you?
- Regarding the scenario description and instruction were they clear? (1 not at all - 5 very much).



The screenshot shows a feedback form on a tablet. The form has a green header with the word "Feedback" in white. Below the header is a small green icon of a person. The first question is "Overall, how difficult did you find the game? (1 not difficult - 5 very difficult)" with radio buttons for options 1 through 5. The second question is "Considering your results, is there any answer that you would change?" followed by a large white text input field with the placeholder text "write a comment". The third question is "Do you think you had enough time? (1 not enough time - 5 enough time)" with radio buttons for options 1 through 5. At the bottom, there is a line of text: "Before completing the simulation, please try to describe the 'RES4CITY GAME' using three adjectives".

Figure 75. Screenshot - Feedback form