

# Game

## CIRCULAR CHEMISTRY CHALLENGE

### Instructions on English

Erasmus+ Project

CIRCULAR CHEMISTRY IN THE DIGITAL ERA

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## Circular Chemistry Challenge

Circular Chemistry Challenge is a fun and educational game that teaches players about sustainable chemistry and the principles of the circular economy. Designed as part of the Erasmus+ Project 'Circular Chemistry in the Digital Era' the game offers an interesting way for players to explore real-world environmental challenges while learning about topics such as chemical pollution, sustainable product creation and renewable energy. Players are tasked with solving these challenges while balancing resources and making strategic decisions that contribute to sustainability.

### BOARD GAME

The game is played on a square board (10 fields per team). The fields are of three kinds:

1. SECONDARY MISSION / QUESTION FIELDS (QF),
2. RESOURCE FIELDS (RF),
3. CHALLENGE FIELDS (CF). Organized in the following manner:

**QF – QF – RF – QF – QF – RF – QF – QF – RF – Presentation field.**

### CARDS

There are six sets of cards based on the 6 missions that in turn is based on the six units.

Each set has:

- 1 MAIN MISSION CARD,
- 6 SECONDARY MISSION (QUESTION) CARDS,
- 6 RESOURCE CARDS
- 6 CHALLENGE CARDS.

There is a points, answer sheet for secondary mission card questions and Presentation Evaluation Rubric (PER).

The **MAIN MISSION CARD** states the general objective and provides instructions.

### SECONDARY MISSION CARDS

Secondary Mission Cards are essential for progressing the gameplay, giving players' decision-making process direction and structure, and ultimately helping them accomplish the main mission goal of setting up a profitable manufacturing or recycling operation.

The Secondary mission cards contain lists of two types of questions:

- Strategy related questions (1.1)
- Resources question (1.2).

The first questions are points winning questions. Each question bears a certain amount of points designated by the question. For example, Secondary Mission Card 1, question “What measures will you undertake to prevent water pollution” The answer sheet contains several answers, each one worth 15 points, if the team provides additional answer then the game master will decide if the answer is correct and should be awarded. The team collects points for the correct answer. If the team fails to provide correct or complete answer, the competing team is entitled to provide additional answer and gain points

The questions 1.2 are preparatory questions, to make the team think about the types of resources they may need to successfully achieve the secondary mission. They don't bring points for the team.

### **RESOURCE CARDS:**

Resource Cards are essential instruments for players in the quest to create and run profitable recycling plants. These cards provide players with a wide range of resources, such as money, technological know-how, and organizational abilities, enabling them to successfully handle obstacles and pursue strategic goals. Through tactical resource acquisition and allocation, players can enhance their operations, refine critical skills, and adjust to shifting conditions as the game progresses. Resource Cards give players the adaptability and versatility required to successfully navigate the complexities of sustainability-focused entrepreneurship, whether it's raising money for equipment upgrades, teaching staff advanced recycling techniques, or creating marketing strategies to promote recyclable goods.

The resource cards offer these types of resources:

- Money
- Technological know-how (specific and non-specific)
- Organizational know how (specific and non-specific)
- Mixed

The technological know-how and the organizational know how are of two categories: non specific and specific, the former specify the type of skill(s) players can buy, for example YOU CAN BUY WATER POLUTITION PROTECTION EXPERIENCE / SKILL for 10 points, or general “YOU CAN BUY ANY TYPE OF EXEPERIENCE / SKILLS ON YOUR OWN CHOICE for 15 points

If a team has less points but wants to buy some of the resources, they can draw a challenge card and with correct answer to earn 15 points.

### **Challenge cards**

Players' gameplay experience is improved by the addition of unpredictability and strategic decision-making provided by Challenge Cards. These cards, which come in two varieties—game challenge cards and player challenge cards—present players with a range of situations and challenges linked to running their recycling plants. Challenge Cards assess players' ability to solve problems and think of creative solutions, from fixing equipment failures to streamlining production and adjusting to competitive markets. Completing tasks successfully not only grants players bonus points but also replicates the complexity and

unpredictabilities of sustainable business management in the real world. Challenge Cards require players to think critically, work well in teams, and showcase their abilities as eco-aware business owners.

The **CHALLENGE CARDS** are of two types:

- Game challenge cards and
- Player challenge cards.

**The first questions are related to the questions contained in each secondary mission card.**

A successful response to a challenge brings additional 50 points per answer to the team. They can choose to skip the challenge.

They can choose two challenges. And after collecting or losing points, they can choose to buy more resources from the same resources before they do the presentation strategy.

## **SUMMARIZATION OF POINTS AWARDED**

**Points are given in the game for the following kinds of tasks:**

### **1. Cards for Secondary Missions:**

Correct responses to strategy-related questions (1.1) on the Secondary Mission Cards gain points for teams. A set amount of points, usually indicated on the card, is awarded for each correct response; for example, **15 points are awarded for each accurate response.** Extra points can be given for creative solutions or responses other than those on the answer sheet; these are usually selected by the game master.

### **2. Resource cards:**

The additional resources and skills stated on the Resource Cards can be obtained with points, which function as cash. Teams use their acquired points in accordance with the costs listed on the cards for each ability or resource. The team's final score will include any unused points at the conclusion of the game. If a team has less points after the first two mission cards drawn, but wants to buy some of the resources, they can draw a challenge card and with correct answer to earn 15 points.

### **0. Challenge Cards:**

Completing the challenges found in the Challenge Cards earns you points. A set amount of points is awarded for each task completed successfully, 50 points. The solutions offered are assessed by the game master.

It is possible for a team to win the game without using resource cards to get more resources if they finish the secondary mission cards, get points, and then create a strong plan with the resources they already had at the start. This method places a strong emphasis on resource allocation that is smart, creative in making the most use of the available resources, and

strategic thinking. It demonstrates the group's capacity to set priorities, reach well-informed conclusions, and create a well-thought-out plan of action based on goals and strengths.

- **Presentation field:** Right after landing on the Presentation Field (GREEN FIELD), each team gains 10 bonus points and they have one last chance to buy resources from the resource cards so they can reconfigure the strategy that they are about to present to the Game master.
- Each team then has 10 minutes to wrap up the strategy and present it in 3 minutes. The Game Master make an initial evaluation of the strategy based on a Presentation Evaluation Rubric (PER) Each strategy is worth X points based on defined criteria contained in the PER
- The strategy is then “questioned” by the opponent who has the right to make a question. The relevance of the questions is evaluated by the master. Each relevant question is valued 1 point. If the team answers correctly than they get one point per answer.
- When both teams finish with presentation and questioning, the points exchanged for points. And then the points are counted. The team that has greater number of point wins. In case the game continues to the second mission and third, the teams retain the points and draw new mission.

## **Digital game**

Rules of playing the digital game:

- One of the team rolls a dice and the main mission is selected by the number on the dice.
- Both teams roll the dice, the team that has higher number answers first the secondary mission cards.
- Each of the secondary mission cards has 6 possible answers in the form of cards.
- Team one has 3 minutes to discuss between themselves which of the possible answers they will select.
- Team 2 rolls the dice and chooses secondary mission, the mission can be the same secondary mission as the first team.
- The same repeats for round 2 of the secondary missions (QF) for both teams.

Following this pattern: QF – QF – RF – QF – QF – RF – QF – QF – RF

- In the two rounds, both of the teams collect points, 15 points per correct answer. For incorrect answer they lose 15 points.
- Next, teams go to the resources section. Again, they roll a dice, and team 1, got one of the 6 resource cards and choose one of the three options IF THEY WANT TO BUY.
- Next, team 2 chooses the same. It is important that the teams can choose ONLY one option.

- Then 2 rounds of secondary mission go, where both teams answer different secondary missions than the ones they had previously, but missions can be the same between themselves.

- This is repeating following the pattern from above.

- The 10th field is a challenge, which teams can choose to play or not. In this round, players are asked to choose two of the resource cards they have already bought, to solve the challenge. If they consider that these two cards are suitable they can select them. If not, they can either choose to buy new resources with the points they have or they can skip the challenge. For correct answer of the challenge each team gets 5 points. Teams have 5 minutes each, to solve the challenge, if they choose to play.

-For the player challenge, if team 1 rolls a dice and gets a 6, it is selected the player challenge card. It means that the task is meant for team number 2. If team number 2, answers the challenge correctly they get 30 points. If they don't, they lose 30 points.

-At the same time, team number 2 rolls the dice, and they can get a non-player challenge (if they roll the dice with numbers 1 to 5). They have a chance to win points twice in this round (only if team 1 rolls a dice with a number which will assign team 2 a player challenge card, and team 2 rolls the dice with number assigning them with game challenge card)

- In this step it is important, that these points are awarded offline (with teacher involved, as the system doesn't have a way to do this)

- In the end teams collect their points and resources they have left and the team that has more is the winner.

-It is important to note, that the game if it is played in the classroom, two teams can play in two devices, smartphone/iphone, the winner can be announced by the teachers, as the mobile application is available for download on iOS and playstore, but it is played offline.

## **MISSION 1: BASED ON THE TOPIC FROM THE CURRICULUM:**

### **TOWARDS ZERO CHEMICAL POLLUTION IN THE ENVIRONMENT WITH THE FOCUS ON ECOLOGY**

#### **Main Mission Card**

Your mission is to collect all necessary resources and create a strategy that will make the recycling unit successful by devising sub strategies contained in each QUESTION FIELD.

**Your goal is to establish a manufacturing or recycling facility that can serve 500,000 people.**

#### **Initial Resources:**

€50,000 as a starting capital

#### **Team:**

1 Industry Designer,

1 Chemical Engineer

3 General Workers

**Facility:** The unit will be housed in an abandoned house.

Your first task is to think what waste/materials you will collect for your factory and discuss it with your group about all necessary resources (money, technical skills, and organizational skills/actions) related to: a) waste management, b) machines and operation, c) recycling process, d) social outreach e) safety f) expansion (These are the secondary missions)

This is just a brainstorm round of 10 minutes, with a possibility to ask the Game Master a question. There are no points awarded in this round it is just to understand and maybe get a little guidance from the Game master.

The 6 mission secondary mission cards are following:

#### **Q1: Waste management:**

1. What measures will you undertake to prevent water pollution and what will you do with the non-recyclable waste?

**(Correct: Implement advanced filtration systems, Follow all waste management protocols, Invest in Research for Sustainable solutions. (15 POINTS FOR EACH CORRECT)**

**(Incorrect: Burn all waste, Throw all waste in the landfills, Dispose waste in the water) (-15 POINTS FOR EACH INCORRECT)**

- 1.2 Think about money, what skills and what organizational skills and actions do you need to accomplish this

**Q2: Machine and operation:**

1. How do machines work, and what will you do so the employees will have the skills to operate them?"

**(Correct: Safety training for employees, Continuous education trainings for employees, Machine training for new employees)**

**Incorrect: No maintenance is needed, The sorting will be manual, Machines require no training)**

0. How much money, what skills and what organizational skills and actions do you need to accomplish this?

**Q3: Recycling process:**

1. "Chemical recycling: effect on environment, does chemical recycling affect higher demand of produce? why should consumers choose recycled goods?"

**(Correct: Decreases demand for new materials, Lowers carbon footprint, Has effect on reducing waste in landfills)**

**Incorrect: Pollution is increased, Has no effect on the environment at all, Creates more non-recyclable waste)**

0. How much money, what skills and what organizational skills and actions do you need to accomplish this?

**Q4: Social outreach:**

1. Raising awareness campaign, cooperation with beneficiaries. How would you organize awareness raising campaign? What kind of campaign? How will you cooperate with local businesses, create a waste distribution network, etc.

**Correct: Forming partnerships with local businesses, Create a waste collection schedule, Organize recycling workshops in cooperation with local NGOs)**

**Wrong: Just post on social media, Do an awareness campaign once per year, Schools should not be included in the campaigns)**

0. How much money, what skills and what organizational skills and actions do you need to accomplish this?

**Q5: Safety:**

1. What are the risks, what protective equipment you need?
2. How much money, what skills and what organizational skills and actions do you need to accomplish this?

**Correct: Use gloves and safety goggles to handle materials, Conduct regular safety trainings, Ventillation systems will be installed)**

**Wrong: Flammable materials should be stored together, Allow high noise levels, no need for protective equipment)**

**Q6: “Expansion: developing new products made by recycled materials”**

1. What products can you develop by using the waste, what machines?

**Correct: Plastic items using injection molders, metal items using CNC machines, Paper boxes using machines like shredders, pressers**

**Wrong: Create big plastic products using handheat gun, Product produced by recycling with hand tools, large plastic products with 3d printing**

0. How much money, what skills and what organizational skills and actions do you need to accomplish this?

**Resource Card 1: Financial Resources**

- 10,000 euros for 5 points
- 50,000 euros for 20 points
- 100,000 euros for 40 points

**Resource Card 2: Technological Know-How - Specific Skills**

- Competency with waste sorting technology for 10 points
- Training in recycling equipment maintenance for 10 points
- Understanding of environmentally friendly packaging materials for 10 points

**Resource Card 3: Technological Know-How – Non-Specific Skills**

- Any kind of technical expertise in recycling – 15 points
- Advanced instruction on environmentally friendly production techniques – 20 points
- Comprehending environmental standards in order to handle waste – 25 points

**Resource Card 4: Organizational Know-How - Specific Skills**

- Creating a marketing plan aimed at promoting recyclable goods – 10 points
- Ability to manage networks for the collection and distribution of waste – 10 points
- knowledge of how to get permissions and follow rules about the environment – 10 points

**Resource Card 5: Organizational Know-How – Non-specific Skills**

- Knowledge and skills in various aspects in entrepreneurship – 15 points
- Skills in strategies for community engagement and outreach – 20 points
- Project managements skills – 25 points

**Resource Card 6: Mixed Resources**

- 20,000 euros and competence with waste sorting technology – 15 points

- 60,000 euros and promotional strategies for recycled goods -25 points
- 120,000 euros and any technical or administrative abilities – 40 points

### **Challenge card 1 (related to O5)**

"Your recycling unit's filtration system has malfunctioned, leading one of the machines to produce additional waste. Without pausing production or adversely altering work dynamics and profit, use 2 of your current resources to solve the problem or buy using the resources you have. (If they bought one of these resources in the previous round they can use it here

#### **Resource Card 2: Technological Know-How - Specific Skills**

- **Competency with waste sorting technology (10 points)**
  - Use this resource to apply technical expertise in diagnosing and repairing the malfunctioning filtration system swiftly and effectively. Competency in waste sorting technology often includes knowledge of industrial equipment maintenance, which can be crucial for identifying and resolving issues promptly.

#### **Resource Card 1: Financial Resources**

- **50,000 euros for 20 points**
  - This money can be used to procure necessary replacement parts or hire specialized technicians to repair the filtration system. This funding can also cover emergency maintenance costs without impacting ongoing production schedules or profitability.

#### **Resource Card 3: Technological Know-How - Non-Specific Skills**

#### **Advanced Instruction on Environmentally Friendly Production Techniques - 20 points**

Implement environmentally friendly production techniques to reduce waste:

#### **Resource Card 4: Organizational Know-How - Specific Skills**

#### **Creating a Marketing Plan Aimed at Promoting Recyclable Goods - 10 points**

Promote recycled goods to maintain profitability:)

### **Challenge card 2 (related to O2)**

"Due to an increase in demand for recycled plastics, your current systems for detecting and sorting different types of plastics are overwhelmed. Use 2 of your resources to optimize sorting efficiency and increase output of high-quality recycled plastics. (Possible answers:

#### **Resource Card 2: Technological Know-How - Specific Skills**

- **Competency with waste sorting technology (10 points)**
  - Apply this resource to improve and upgrade your current plastic sorting systems. Enhance the capabilities of sorting technologies to accurately identify and segregate various types of plastics, ensuring higher efficiency and reducing sorting errors.

### **Resource Card 3: Technological Know-How - Non-Specific Skills**

#### **Advanced Instruction on Environmentally Friendly Production Techniques - 20 points**

Implement techniques to enhance recycled plastic quality

### **Resource Card 4: Organizational Know-How - Specific Skills**

#### **Ability to Manage Networks for Collection and Distribution of Waste - 10 points**

Optimize waste collection and distribution networks )

### **Resource Card 6: Mixed Resources**

- **60,000 euros and promotional strategies for recycled goods (25 points)**
  - It will serve towards investing in advanced sorting equipment or upgrading existing technologies.
  - Use promotional strategies for recycled goods to enhance market visibility and attract more demand for high-quality recycled plastics, thereby justifying the investment in sorting efficiency improvements. )

### **Challenge card 3 (related to Q3 and Q1)**

"One of the chemical processes in your recycling unit is generating dangerous pollutants. Propose improvements to the process to minimize emissions and assure compliance with environmental laws while preserving production efficiency, using 2 of your current resources to solve the problem or buy using the resources you have."

(Possible answers:

### **Resource Card 2: Technological Know-How - Specific Skills**

#### **Competency with Waste Sorting Technology - 10 points**

Enhance pollution control and waste management

### **Resource Card 3: Technological Know-How - Non-Specific Skills**

- **Advanced instruction on environmentally friendly production techniques**
  - Switching to cleaner chemical reagents or substitutes that reduce pollutant emissions.

- Installing effective air pollution control equipment, such as scrubbers or filters, to capture and neutralize pollutants before release.

· **Resource Card 1: Financial Resources**

- **50,000 euros for 20 points**
  - The money will be used towards investing in infrastructure upgrades or purchasing advanced pollution control technologies. Use the funds to procure and install state-of-the-art emission control systems or upgrade existing equipment to meet stringent environmental standards.

**Resource Card 4: Organizational Know-How - Specific Skills**

**Ability to Manage Networks for Collection and Distribution of Waste - 10 points**

Optimize waste handling to reduce environmental impact)

**Challenge card 4 (related to O6)**

There is a new method for recycling chemicals that promises better yields and less of an impact on the environment. Examine the viability and possible advantages of implementing this method in your recycling department, using 2 of your current resources or buy using the resources you have."

(Possible answers:

**Resource Card 2: Technological Know-How - Specific Skills**

**Competency with Waste Sorting Technology - 10 points**

Evaluate technology compatibility with new recycling method

**Resource Card 3: Technological Know-How - Non-Specific Skills**

- **Advanced instruction on environmentally friendly production techniques** Apply expertise in environmentally friendly production techniques to analyze how the new method aligns with sustainability goals and regulatory requirements.

· **Resource Card 1: Financial Resources 100,000 euros**

- Money can be used in conducting feasibility studies, pilot testing, and initial implementation costs of the new chemical recycling method, necessary equipment, research and development, and training for personnel involved in adopting the new technology.

## **Resource Card 4: Organizational Know-How - Specific Skills**

### **Creating a Marketing Plan Aimed at Promoting Recyclable Goods - 10 points**

Promote advantages of new method to stakeholders)

### **Challenge card 5 (related to Q1)**

"Other recycling plant has drawn interest and business with a unique approach to recycling electronic waste. Use 2 of your resources to maintain market share in the recycling of electronic waste while highlighting the benefits of your company's recycling procedures.

(Possible answers:

## **Resource Card 2: Technological Know-How - Specific Skills**

### **Understanding of Environmentally Friendly Packaging Materials - 10 points**

Enhance packaging for electronic waste recycling

## **Resource Card 3: Technological Know-How - Non-Specific Skills**

### **Advanced Instruction on Environmentally Friendly Production Techniques - 20 points**

Implement sustainable practices in electronic waste recycling

## **Resource Card 4: Organizational Know-How - Specific Skills**

- Creating a marketing plan aimed at promoting recyclable goods

## **Resource Card 5: Organizational Know-How - Non-specific Skills**

- **Skills in strategies for community engagement and outreach (20 points)**
  - Apply this resource to engage with the community, industry partners, and stakeholders to build awareness and trust in your electronic waste recycling services.

### **Player challenge card**

The second type of Challenge card is the **player challenge card**, which if drawn the team is entitled to pose a challenge to the other team. The card would look like

**"Ask your opponent cut back on their water usage by 20% while recycling. Propose measure/techniques to save water without sacrificing the recycling process' efficiency. Using 2 of the resource card, or the team can buy with the funds/points they already have.**

## **(Resource Card 3: Technological Know-How - Non-Specific Skills**

### **Advanced Instruction on Environmentally Friendly Production Techniques - 20 points**

Implement water-saving techniques in recycling processes

**Resource Card 1: Financial Resources**

- **50,000 euros for 20 points**
  - Invest in water-saving infrastructure upgrades. Implement closed-loop water systems that recycle and reuse water within the recycling process, reducing overall consumption.)

**Resource Card 2: Technological Know-How - Specific Skills**

**Training in Recycling Equipment Maintenance - 10 points**

**Ensure optimal equipment performance to minimize water usage**

**Resource Card 4: Organizational Know-How - Specific Skills**

Ability to Manage Networks for Collection and Distribution of Waste - 10 points

Streamline waste collection to reduce water consumption )

## **MISSION 2: BASED ON THE TOPIC FROM THE CURRICULUM:**

**(sustainable chemicals for circular economy)**

### **Main Mission Card**

Your goal is to create and put into practice sustainable business plans for your companies that maximize competitiveness and economic growth while reducing their negative effects on the environment.

#### **Initial Resources:**

€75,000 as a starting capital

#### **Team and equipment:**

- 1 chemical engineer with expertise in sustainable environmental practices, product development, and chemical processes.
- Access to lab spaces with standard analytical tools and apparatus for carrying out research, testing product prototypes, and assessing how their chemical processes affect the environment.
- 3 General Workers

Your first task is to think what waste/materials you will collect for your factory and discuss it with your group about all necessary resources (money, technical skills, and organizational skills/actions) related to: a) eco-friendly product development, b) strategies for reducing waste, c) ecological supply chain management, d) assessment of environmental impact e) principles of circular design f) education and community involvement (These are the secondary missions)

This is just a brainstorm round of 10 minutes, with a possibility to ask the Game Master a question. There are no points awarded in this round it is just to understand and maybe get a little guidance from the Game master.

Next, we have the secondary mission cards:

### **Secondary Mission Card 1: Eco-Friendly Product Development**

1.1 How can your company create environmentally friendly products utilising sustainable resources or recycled materials, and what measures will you take to make sure the final products are both marketable and friendly to the environment?

Accurate Responses:

1. Recycled materials, eco-certifications, market promotion.
2. Lifecycle assessment, renewable energy use, transparent labeling
3. Biodegradable materials, waste reduction, consumer education

False responses

1. Ignore sustainability, focus on cost reduction.
2. No changes, rely on traditional marketing strategies.
3. No sustainability plan, prioritize market trends.

1.2 What kind of study and testing is required to design and produce new goods that support the circular economy, and how will you explain to customers the advantages of these goods?

### **Secondary Mission Card 2: Strategies for reducing waste**

1.1 How will your company include waste reduction strategies into its production processes, and what creative methods can you create to reduce waste production and encourage resource efficiency?

Accurate Responses:

1. Put recycling programs into place, make packaging better, and reuse materials.
2. Use production optimization techniques and reduce waste
3. Use biodegradable packaging, train employees, and keep an eye on waste statistics.

incorrect responses

1. Disregard waste and concentrate exclusively on production effectiveness.
2. Maintain present procedures without a waste reduction strategy.
3. Lower expenses by reducing waste management costs.

1.2 What tools and steps are needed to put waste reduction plans into action, and how will you assess how well these tactics are working to lessen their negative effects on the environment?

### **Secondary Mission Card 3: Ecological Supply Chain Management**

1.1 What alliances or partnerships can you form to support sustainable practices, and how can your business assure sustainability throughout its supply chain, from obtaining raw materials to distributing finished goods?

**Correct:**

1. Form partnerships with sustainability-focused groups, NGOs, and eco-certified suppliers.
2. Monitor supply chain indicators, conduct sustainable sourcing audits, and encourage openness.
3. Work together with academic institutions, nearby communities, and eco-friendly certifications.

**Incorrect:**

1. No joint ventures; simply consider expenses and earnings.
2. Disregard the supply chain and put speed ahead of sustainability.
3. Use supplies who don't follow sustainable procedures.

1.2 What preparation and investigation are required to find sustainable suppliers, find the best routes for transportation, and apply moral and ecologically friendly supply chain management techniques?

#### **Secondary Mission Card 4: Assessment of Environmental Impact**

1.1 How will your company evaluate and lessen its influence on the environment? What instruments or techniques are you able to employ to quantify greenhouse gas emissions, resource usage, and other environmental metrics?

Accurate Responses:

1. Monitor energy use and conduct environmental audits.
2. Put in place waste audits, water consumption evaluations, and carbon footprint tracking.
3. Make investments in eco-friendly activities, embrace renewable energy, and obtain sustainability certifications.

Wrong responses

Ignore impact, focus on business growth.

Use outdated metrics, avoid technology.

No quantification, rely on estimates.

1.2 How will you use the results of an environmental impact assessment to enhance sustainability performance and regulatory compliance? What data gathering and analysis strategies are required?

#### **Secondary Mission Card 5: Principles of Circular Design**

1.1 What circular design techniques can your company use to reduce waste and lengthen product life cycles? How can you incorporate durability, repairability, and recyclability into the process of developing new products?

Correct Answers:

1. Design for disassembly, and use renewable materials.
2. Ensure modular design, prioritise repairability.
3. Implement closed-loop systems, and educate consumers.

Incorrect Answers:

1. Use non-recyclable materials, avoid durability considerations.
2. No repair options, focus on single-use products.
3. Product lifespan is not important, prioritise short-term profits.

1.2 What studies and trials are required to investigate novel materials, production techniques, and product designs that complement the ideas of the circular economy, and how will you assess the viability and efficacy of these strategies?

### **Secondary Mission Card 6: Education and Community Involvement**

1.1 How will your company interact with local communities to spread knowledge about the circular economy? What outreach or education projects can you create to encourage people and companies to embrace sustainable practices?

#### **Correct Responses:**

Partner with schools, engage in community events.

Create educational campaigns, collaborate with local organizations."

Encourage eco-friendly activities, and support community gardens.

#### **Wrong**

1. Avoid local involvement, focus on global markets.
2. No sustainability messaging, market products aggressively.
3. Ignore community needs, prioritize cost-cutting measures.

1.2 How will you gauge the success of community events, seminars, or educational campaigns in cultivating environmental stewardship and advancing a sustainable culture? What tools and activities are required?

#### **Resource Cards**

##### **Resource Card 1: Financial Resources**

- 15,000 euros for 5 points
- 60,000 euros for 20 points
- 120,000 euros for 40 points

##### **Resource Card 2: Technological Know-How - Specific Skills**

- competence in the handling of complex chemical waste – 10 points
- training in sustainable manufacturing line management – 10 points
- expertise in developing biodegradable materials -10 points

##### **Resource Card 3: Technological Know-How – Non-Specific Skills**

- general competence with cutting-edge recycling methods – 15 points
- Modern techniques for reducing pollution – 20 points

- Knowledge of the fundamentals of green chemistry -25 points

#### **Resource Card 4: Organizational Know-How - Specific Skills**

- Creating a sustainability-focused public relations campaign – 10 points
- Logistical expertise for effective material recovery -10 points
- Ability to successfully obtain funding from the government for environmental projects – 10 points

#### **Resource Card 5: Organizational Know-How – Non-specific Skills**

- General understanding of sustainable business management – 15 points
- Techniques for engaging the community to support recycling initiatives – 20 points
- Advanced project management abilities for green projects – 25 points

#### **Resource Card 6: Mixed Resources**

- €25,000 as well as proficiency in treating sophisticated chemical waste - 15 points
- €75,000 sustainable production line management training, - 25 points
- €150,000, and any other selected technical or organizational skill -40 points

### **Challenge cards**

#### **Challenge card 1 (related to Q1 and Q5)**

"Although your company has created an amazing environmentally friendly product, there are doubts regarding its durability over time. Use 2 of the resource cards to enhance this product's durability without sacrificing its environmental advantages..

#### **Correct answers**

#### **(Resource Card 2: Technological Know-How - Specific Skills**

- expertise in developing biodegradable materials - 10 points

Invest in additional research and development with durable, biodegradable materials; emphasize enhancing the product's longevity and structural integrity without adding to its environmental impact.

#### **Resource Card 3: Technological Know-How – Non-Specific Skills**

- Knowledge of the fundamentals of green chemistry - 25 points

#### **Resource Card 4: Organizational Know-How - Specific Skills**

#### **Logistical Expertise for Effective Material Recovery - 10 points**

Optimize material recovery processes to extend the product's lifecycle. Ensure that recovered materials can be reintegrated into the manufacturing process effectively, maintaining both durability and environmental benefits.

**Resource Card 6: Sustainable Production Line Management Training - 30 points and Mixed Resources - €75,000**

Invest in eco-friendly production methods to increase the longevity of your products. This entails implementing lean manufacturing concepts, improving quality assurance procedures, and making certain that environmentally friendly practices are integrated throughout the entire production process. )

**Challenge card 2 (related to Q2)**

"There is now more waste due to a sudden spike in production. Use 2 of the resource cards to control and lessen this waste surge while maintaining the production line's efficiency

**(Resource Card 2: Technological Know-How - Specific Skills**

**Competence in the Handling of Complex Chemical Waste - 10 points**

Utilize this expertise to manage waste generated from increased production:

**Resource Card 3: Technological Know-How – Non-Specific Skills**

- Modern techniques for reducing pollution – 20 points

Implement pollution reduction techniques to minimize waste generation:

**Resource Card 4: Organizational Know-How - Specific Skills**

- Logistical expertise for effective material recovery - 10 points

Enhance material recovery logistics to manage increased waste:

**Resource Card 5: Organizational Know-How - Non-specific Skills**

**Techniques for Engaging the Community to Support Recycling Initiatives - 20 points)**

**Challenge card 3 (related to Q3 and Q1)**

"Your main supplier of raw materials has been found to be using unsustainable practices. Use 2 of the resource cards to either work with this supplier to improve their practices or to find a new, more sustainable supplier without disrupting your production.."

**(Resource Card 3: Technological Know-How – Non-Specific Skills**

- Knowledge of the fundamentals of green chemistry - 25 points

This expertise can help in evaluating and suggesting sustainable alternatives or improvements in the raw material sourcing and production processes.

**Resource card 4: Ability to Successfully Obtain Funding from the Government for Environmental Projects - 10 points**

Secure funding to support your supplier's transition to sustainable practices

**Resource Card 5: Organizational Know-How - Non-specific Skills**

**Advanced Project Management Abilities for Green Projects - 25 points**

Implement a project management approach to facilitate the transition:

**Resource Card 6: Mixed Resources**

- €150,000, and any other selected technical or organizational skill

The financial resources can be used to invest in research and development or to incentivize suppliers who are willing to adopt sustainable practices. Additionally, the ability to select another technical or organisational skill can be used to strengthen your company's ability to find and negotiate with new suppliers. )

**Challenge card 4 (related to Q4)**

According to an audit, your company uses a lot more energy than is typical for the industry. Use 2 of the resource cards for cutting the amount of energy used in all processes, emphasising both immediate and long-term fixes.

**(Resource Card 6: Mixed Resources**

- €75,000 sustainable production line management training

Investing in sustainable production line management training can educate your staff on energy-efficient practices, optimising workflow to reduce energy consumption over the long term.

**Resource Card 4: Organisational Know-How - Specific Skills**

- Logistical expertise for effective material recovery - 10 points

This skill can be applied to streamline material flows and minimise waste, which indirectly reduces energy consumption associated with handling and processing materials.)

**Resource Card 2: Technological Know-How - Specific Skills**

**Training in Sustainable Manufacturing Line Management - 10 points**

Implement sustainable practices in manufacturing processes:

### **Resource Card 5: Organizational Know-How - Non-specific Skills**

#### **Techniques for Engaging the Community to Support Recycling Initiatives - 20 points**

Extend community engagement to energy reduction initiatives. Collaborate with local communities to promote energy-saving behaviors and initiatives

#### **Challenge card 5 (related to Q1)**

"A local organization has expressed worries regarding the environmental impact of your business. Use 2 of the resource cards to calm their worries, inform them of your sustainable initiatives, and promote trust.

### **(Resource Card 2: Technological Know-How - Specific Skills**

#### **Expertise in Developing Biodegradable Materials - 10 points**

Highlight sustainable product material

### **Resource Card 3: Technological Know-How - Non-Specific Skills**

#### **Modern Techniques for Reducing Pollution - 20 points**

Implement pollution reduction techniques: Emphasize projects like waste reduction plans, emissions control methods, and energy efficiency upgrades.

### **Resource Card 4: Organizational Know-How - Specific Skills**

- Creating a sustainability-focused public relations campaign – 10 points

This skill can be used to create targeted communication materials that highlight your company's sustainable practices, initiatives, and commitment to environmental responsibility.

### **Resource Card 5: Organizational Know-How – Non-specific Skills**

- Techniques for engaging the community to support recycling initiatives – 20 points

Engaging with the local community through recycling initiatives and other sustainable activities can demonstrate your company's proactive approach towards environmental stewardship and build positive relationships.)

#### **Player challenge card**

" Assign your opponent the task of reducing their chemical emissions by 20% while maintaining the effectiveness of their production of sustainable chemicals. Use 2 of the resource cards to reduce chemical pollution without sacrificing the efficiency of production."

### **(Resource Card 2: Technological Know-How - Specific Skills**

- expertise in developing biodegradable materials - 10 points

This expertise can help in reformulating chemicals to be more biodegradable or environmentally friendly, thereby reducing the impact of chemical emissions without compromising production efficiency.

### **Resource Card 3: Technological Know-How – Non-Specific Skills**

- Modern techniques for reducing pollution – 20 points

These techniques can include process optimization, cleaner production methods, and waste minimization strategies that can significantly reduce chemical emissions while maintaining production effectiveness.

### **Resource card 4: Creating a Sustainability-Focused Public Relations Campaign - 10 points**

Launch a campaign to promote sustainable chemical production

### **Resource card 5: Techniques for Engaging the Community to Support Recycling Initiatives - 20 points**

- Collaborate with local communities to raise awareness about chemical emissions and their environmental impacts.)

### **MISSION 3: BASED ON THE TOPIC FROM THE CURRICULUM:**

**(Safety and sustainability standards outside the EU – waste as a resource)**

#### **Main Mission Card**

**Your mission is to promote sustainability and safety standards in your non-EU recycling unit, while highlighting waste as a valuable resource.**

#### **Initial Resources:**

€50,000 as a start capital per team

Team:

3 General Workers,

1 Chemical Engineer, and

1 Industry Designer

Your first task is to think what waste/materials you will collect for your factory and discuss it with your group about all necessary resources (money, technical skills, and organizational skills/actions) related to: a) eco-friendly product development, b) strategies for reducing waste, c) ecological supply chain management, d) assessment of environmental impact e) principles of circular design f) education and community involvement (These are the secondary missions)

This is just a brainstorm round of 10 minutes, with a possibility to ask the Game Master a question. There are no points awarded in this round it is just to understand and maybe get a little guidance from the Game master.

Next, we have the secondary mission cards:

The 6 mission secondary mission cards are following:

Secondary Mission Cards:

#### **1. Waste Management:**

**Secondary Mission Card:**

- **Strategy related question (1.1):** In your opinion what measures can be implemented to prevent water pollution and manage non-recyclable waste effectively in countries outside the EU?

Correct:

- To have strict industrial waste regulations to limit pollution.
- To have public education campaigns on waste management
- To invest in advanced waste treatment facilities

Wrong:

- To rely just on volunteer cleanup actions
- To ignore agricultural runoff as a source of water pollution.
- To burn waste without proper emissions controls.)

**Resources question (1.2):** What basic source of finances, expertise, and organizational actions are needed to carry out these waste management strategies effectively in non-EU regions?

## 2. Social Outreach:

### Secondary Mission Card:

- **Strategy related question (1.1):** Can you share 3 tips on how to promote recycling and sustainable waste management practices in non-EU countries.

Correct

- Implement incentive programs for households and businesses to recycle.
- Develop waste segregation systems at the community level.
- Deliver education on sustainable waste management practices.

Wrong

- People should dispose of waste just on landfills
- Rely on informal waste collectors without any regulations.
- No public awareness campaigns are needed.

**Resources question (1.2):** What finances, skills, and organizational skills are required to engage local communities and businesses in sustainable waste management?

## 3. Safety and Compliance:

### Secondary Mission Card:

- **Strategy related question (1.1):** What are potential risks in recycling processes in non-EU countries?

Correct Answers :

- Inadequate facilities can cause environmental pollution.
- Lack of regulation means unsafe recycling practices.
- Informal sectors may expose workers to toxic materials.

Incorrect Answers:

- Non-EU countries have no risks in recycling processes.
- Recycling in non-EU countries is automatic and risk free
- Advanced technology means there are no risks in non-EU countries.

**Resources question (1.2):** How can basic funding, knowledge sharing, and organizational planning help meet international safety and environmental standards when setting up recycling initiatives outside the EU?

#### **4. Resource Allocation:**

##### **Secondary Mission Card:**

**Strategy related question (1.1):** How are you gonna allocate limited budget to invest in essential recycling technologies and basic training programs in regions outside the EU.

Correct Answers:

1. Invest in low-cost sorting tech and basic safety training programs.
2. Allocate funds to mobile recycling units and community education.
3. Prioritize waste-to-energy systems and waste handling training.

Wrong Answers:

1. Spend the entire budget on luxury recycling tech with no training
2. Invest only in a few employees, to have recycling certifications
3. Use the budget for recycling marketing, not technology.

**Resources question (1.2):** What fundamental skills and technological advancements are necessary to improve waste sorting and recycling efficiency in non-EU countries?

#### **5. Expansion and Innovation:**

##### **Secondary Mission Card:**

**Strategy related question (1.1):** Brainstorm creative ideas for new products made from recycled materials that could be produced sustainably in non-EU regions.

Correct Answers:

1. Recycled plastic building materials for sustainable construction.
2. Fashionable accessories using upcycled textiles and metals.

3. Eco-friendly furniture crafted from reclaimed wood.

Wrong Answers:

1. Disposable plastic items
2. Toys from mixed recycled waste without safety standards.
3. Products requiring advanced technology, not local.

**Resources question (1.2):** How can modest investments, basic expertise, and thoughtful planning facilitate the growth and sustainability of recycling operations outside the EU?

**6. Secondary Mission Card: Policy and laws**

**Strategy related question (1.1):** Check current waste management rules in non-EU countries and propose ways to create new policies that encourage more recycling and less trash in landfills.

Correct Answers:

1. Give incentives to businesses using recycled materials.
2. Implement recycling programs with education
3. Punish non-compliance with recycling rules.

Wrong Answers:

1. There shouldn't be any other option except recycling.
2. Raise landfill taxes with no waste options
3. Enforce recycling quotas without infrastructure support.

**Resources question (1.2):** What kind of help from legal experts, support from the government, and teamwork with local groups are needed to make sure these new rules work well in non-EU areas?

**Resource cards**

**Financial Resources:**

**Resource Card 1: Money**

- €5,000 - 5 points
- €10,000 - 10 points
- €20,000 - 20 points

**Technical Know-How - Specific Skills:**

**Resource Card 2:**

- Training in Basic Waste Sorting Techniques – 10 points
- Introduction to Sustainable Packaging Materials - 10 points
- Basic Knowledge of Safety Protocols in Recycling - 10 points

**Technical Know-How - Non-Specific Skills:**

**Resource Card 3:**

- General Technical Expertise in Recycling – 15 points
- Advanced Instruction on Sustainable Production Techniques -25 points
- Understanding International Environmental Standards -45 points

**Organizational Know-How - Specific Skills:**

**Resource Card 4:**

- Creating a Local Awareness Campaign – 10 points
- Building a Basic Waste Distribution Network – 10 points
- Managing Local Recycling Programs – 10 points

**Resource Card 5: Organizational Know-How - Non-Specific Skills:**

- Skills in Entrepreneurship and Sustainability – 15 points
- Project Management Skills – 20 points
- Strategies for Community Engagement -25 points

**Resource Card 6: Mixed Resources**

- €15,000 and Education in Waste Sorting Techniques – 20 points
- €30,000 and Advanced Knowledge of Sustainable Production Techniques – 30 points
- €50,000 and Skills in Project Management– 45 points

**Challenge Card 1 (related to Waste Management and Laws and policies):**

- **Challenge:** "Despite efforts to recycle, local water sources are still polluted due to improper waste disposal. Using 2 of your resource cards propose how to improve waste management practices to prevent water pollution in non-EU countries.

**(Resource Card 1: Money**

- €20,000 (20 points)

Use this budget to establish and enhance local recycling programs and waste treatment facilities near water sources.

### **Resource Card 3: Technical Know-How - Non-Specific Skills**

- Understanding International Environmental Standards (45 points)

Implement international best practices to ensure proper waste disposal and water protection standards are met.)

### **Resource Card 4: Specific Skills - Organizational Know-How**

- **Creating a Local Awareness Campaign (10 points)**

Make advantage of this ability to create and carry out a community awareness program aimed at teaching people the value of appropriate waste disposal and the connection between waste and water pollution.

### **Resource Card No. 6: Mixed Resources**

- **€15,000 and education in Waste Sorting Methods (20 points)**

This will support community-wide awareness-building and the promotion of appropriate waste management techniques.

### **Challenge Card 2 (related to Social Outreach):**

- **Challenge:** "Local communities are not actively involved in recycling programs and lack awareness of the topic. Use 2 of the resource cards to educate and engage community members in sustainable waste management practices.

### **(Resource Card 4: Organizational Know-How - Specific Skills**

- **Creating a Local Awareness Campaign – 10 points**

Utilize this skill to develop and implement targeted campaigns that educate community members about the benefits and methods of recycling.

### **Resource Card 5: Organizational Know-How - Non-Specific Skills**

- Strategies for Community Engagement - 25 points

Implement community engagement strategies to actively involve local residents in recycling programs, fostering participation and commitment to sustainable practices.

### **Resource Card 2: Training in Basic Waste Sorting Techniques (10 points)**

- o Teach locals how to correctly separate trash for recycling by holding training sessions. By doing this, recycling systems will operate more efficiently since recyclable materials and non-recyclable waste will be accurately segregated.

### **Resource Card 6: €15,000 and Education in Waste Sorting Techniques (20 points)**

- o Set aside this money to develop thorough teaching materials on waste sorting methods. Workshops, exhibits, and educational materials can all be a part of these initiatives to teach the community the value of appropriate garbage sorting and recycling.

### **Challenge Card 3 (related to Safety and Compliance):**

- **Challenge:** "Workers at a recycling facility are exposed to harmful chemicals without proper protection. Use 2 of your resource cards in direction to protect workers and comply with environmental regulations.

### **(Resource Card 2: Technical Know-How - Specific Skills**

- Basic Knowledge of Safety Protocols in Recycling – 10 points

Implement training programs to educate workers on safety protocols for handling chemicals and hazardous materials.

### **Resource Card 3: Technical Know-How - Non-Specific Skills**

- Understanding International Environmental Standards – 45 points

Adopt and adhere to international environmental standards to regulate chemical exposure and ensure a safe working environment for employees.

### **Resource Card 5: Organizational Know-How - Non-Specific Skills**

- **Project Management Skills (20 points)**

Create and implement a thorough safety protocol for the recycling facility using your project management skills. This include making the appropriate safety equipment purchases, educating employees on safety protocols, and making sure that safety standards are regularly monitored and followed.

## **Resource Card 6: Mixed Resources**

- **€30,000 and Advanced Knowledge of Sustainable Production Techniques (30 points)**
  - Set aside this amount to buy excellent protection equipment and offer in-depth instruction on sustainable and safe production methods. This will guarantee that the plant complies with environmental rules and that workers are sufficiently safeguarded.)

## **Challenge Card 4 (related to Resource Allocation):**

- **Challenge:** "Due to limited finances, your recycling center struggles to upgrade the technology. Use 2 of your resource cards to allocate resources effectively to improve waste sorting and recycling efficiency.

## **(Resource Card 1: Money**

- €10,000 (10 points)

Allocate this budget to purchase essential equipment upgrades for waste sorting and processing.

## **Resource Card 2: Technical Know-How - Specific Skills**

- Training in Basic Waste Sorting Techniques – 10 points

Invest in training programs to enhance the skills of staff in efficient waste sorting techniques, maximizing the effectiveness of existing equipment.

## **Resource Card 5: Non-specific Skills - Organizational Know-How**

### **Project Management Skills (20 points)**

Apply these skills to efficiently oversee and prioritize the rollout of technological updates. Planning, budgeting, and managing the upgrading process are all part of this to make sure that the cash and resources are used effectively.

## **Resource Card 6: Mixed Resources**

- **€30,000 and Advanced Knowledge of Sustainable Production Techniques (30 points)**

Set aside this combined budget to support staff training in cutting-edge sustainable production methods as well as technology updates. Through sustainable and efficient use of the new technology, this dual strategy will optimize the return on investment.)

### **Challenge Card 5 (related to Q6 - Expansion and Innovation):**

- **Challenge:** "Your recycling efforts are successful, but there's opportunities to create new products from recycled materials. Use 2 resource cards for products that can be made sustainably using recycled materials."

(Resource card 1: €20,000 (20 points))

- This budget can be used for research and development of new products made from recycled materials. Designing prototypes, new equipment, and market research to ensure the new products are viable and sustainable.

### **Resource Card 2: Technical Know-How - Specific Skills**

- Introduction to Sustainable Packaging Materials – 10 points

Utilize this expertise to develop eco-friendly packaging solutions made from recycled materials.

### **Resource Card 3: Technical Know-How - Non-Specific Skills**

- General Technical Expertise in Recycling – 15 points)

### **Resource Card 6: Mixed Resources**

- **€30,000 and Advanced Knowledge of Sustainable Production Techniques (30 points)**

Allocate this combined resource to enhanced training in sustainable production methods as well as to financing the creation of new products from recycled materials. This all-inclusive strategy guarantees the funding and technical know-how required for a successful product launch.

### **Player challenge card**

Your company's new recycling initiative is facing resistance from local authorities due to concerns over increased truck traffic in residential areas. Use 2 resource cards to address these concerns and gain local support for your recycling program."

### **(Resource Card 2: Technical Know-How - Specific Skills**

#### **Introduction to Sustainable Packaging Materials - 10 points**

- Plan workshops to introduce and to inform local government officials and citizens about eco-friendly packaging materials. Emphasize how these materials' improved

packaging can cut down on waste and possibly even the requirement for as many recycling vehicles.

**Resource Card 1: Money €20,000 - 20 points**

- Utilize a portion of the cash to employ logistics professionals who can reduce the impact of truck traffic on residential areas by optimizing truck routes. This can entail planning pickups for off-peak times or taking detours that steer clear of densely populated areas.

**Resource Card 4: Organizational Know-How - Specific Skills**

- Creating a Local Awareness Campaign – 10 points

Launch a campaign to educate residents about the benefits of recycling and how traffic impacts will be minimized.

**Resource Card 5: Organizational Know-How - Non-Specific Skills**

- Strategies for Community Engagement - 25 points

Engage with the community through meetings, surveys, and involvement in decision-making to address concerns and gather feedback for better implementation.)

## **MISSION 4: BASED ON THE TOPIC FROM THE CURRICULUM:**

(Strengthening the EU's open strategic autonomy - chemistry and energy)

### **Main Mission Card**

Develop and implement innovative strategies within your factory to promote sustainable energy solutions, align with circular economy principles, contribute to achieving the SDGs, and strengthen the EU's open strategic autonomy in chemistry and energy.

### **Initial Resources:**

- €50,000 as a starting capital

### **Team**

**1 Environmental Science Specialist:** Has expertise in sustainable practices, product development, and chemical processes. Guides the team in understanding environmental impacts and implementing sustainable solutions.

**3 Team Members:** Students or participants who assist in research, data collection, and project implementation under the guidance of the environmental science specialist.

### **Equipment:**

- **Access to School Laboratory:** Equipped with standard analytical tools such as spectrophotometers, pH meters, and balances.
- **Lab Apparatus:** Includes glassware (beakers, flasks), safety equipment (goggles, gloves), and basic chemical reagents for conducting experiments.
- **Computer with Software:** For data analysis, modeling chemical processes, and preparing presentations.

Students will not only deepen their knowledge but also actively contribute to addressing real-world challenges in energy and environmental sustainability within the EU context. They will discuss about all necessary resources (money, technical skills, and organizational skills/actions) needed to achieve the main mission by answering the secondary mission cards, and they use these points to obtain resource cards that support their strategic plans and facilitate their progress toward achieving the game's goals.

This is just a brainstorm round of 10 minutes, with a possibility to ask the Game Master a question. There are no points awarded in this round it is just to understand and maybe get a little guidance from the Game master.

## **Secondary Mission Card 1: Solar Energy and Photovoltaic Cells**

**Strategy related question (1.1):** How can your factory develop and implement strategies to integrate solar energy and photovoltaic cells into its energy infrastructure to reduce dependence on traditional energy sources and enhance energy security?

**Correct**

1. Offer subsidies for employees installing solar panels at home.
2. Recycle old panels in new product designs.
3. Collaborate with local schools on solar education programs.

**Incorrect:**

1. Ignore solar energy due to initial setup costs.
2. Use non-recyclable materials in solar panel installations.
3. Focus only on traditional energy to cut operational expenses.

**Resources question (1.2):** What funding and technological support are needed to implement solar energy projects at the local level, promoting energy autonomy and sustainability?

## **Secondary Mission Card 2: Chemical Testing for Safe Products**

**Strategy related question (1.1):** What methods can your factory employ to ensure that products undergo rigorous chemical testing to meet safety standards, while incorporating green chemistry principles and promoting sustainable development?

**Correct**

1. Use non-toxic and biodegradable materials in product components.
2. Conduct life cycle assessments to minimize environmental impact.
3. Implement chemical testing protocols aligned with green chemistry principles.

**Incorrect Answers:**

1. Use hazardous chemicals in the manufacturing process.
2. Disregard environmental impact of production methods.
3. Neglect to monitor and manage chemical emissions during production.)

**Resources question (1.2):** How can regulatory bodies and businesses collaborate to improve chemical safety standards and public awareness?

### **Secondary Mission Card 3: Bioenergy from Organic Waste**

**Strategy related question (1.1):** How can your factory convert organic waste into bioenergy or other sustainable energy sources, promoting resource efficiency and supporting circular economy practices?

**Correct:**

- 1: Use anaerobic digestion for biogas from organic waste.
2. Make partnerships with farms to collect organic waste for bioenergy.
- 3: Implement waste-to-energy tech supporting circular economy.

**Wrong:**

- 1: Focus solely on immediate waste disposal methods.
2. Prioritize short-term cost savings over sustainability.
3. The potential of organic waste is not so big, so ignore it

**Resources question (1.2):** What infrastructure and educational programs are needed to encourage the use of bioenergy technologies at the local level?

### **Secondary Mission Card 4: Renewable Energy Integration**

**Strategy related question (1.1):** How can your factory implement solar and wind energy to be effectively integrated to reduce carbon emissions, considering chemical principles?

**Correct:**

1. Monitor emissions and improve energy efficiency.
2. Recycle materials from old panels.
3. Improving the ability to store energy produced by solar and wind for reliable use.

**Wrong:**

1. Focusing on immediate energy needs, ignoring storage.
2. Ignoring seasonal variations in renewable energy production.
3. Ignoring challenges in connecting solar and wind to the grid.

**Resources question (1.2):** What chemical reactions are involved in energy conversion and storage in solar panels and wind turbines, and how do these principles influence their efficiency and environmental impact?

### **Secondary Mission Card 5: EU's Energy Goals**

**Strategy Related Question (5.1):** How can your factory contribute towards achieving the EU's energy goals, such as improving energy efficiency and increasing the use of renewable energy sources, to support circular economy principles and strategic autonomy in energy?

Correct:

Educate employees on energy conservation and sustainability.

Collaborate with EU initiatives for renewable energy innovation.

Invest in energy-efficient technologies and practices.

Incorrect:

Use linear production models

No need for local energy partnerships

Focusing on immediate production targets instead of long-term energy goals.

**Resources question (1.2):** What funding, research, and international teamwork are needed to reach these energy goals?

### **Secondary Mission Card: Circular Energy**

**Strategy related question (1.1):** How can your factory incorporate circular energy practices, where materials and energy are reused or recycled, into its operations to support environmental goals and strengthen the EU's strategic autonomy in chemistry and energy?

Correct

Investing in energy recovery from waste streams.

Implementing closed-loop recycling systems for materials.

Educating employees on circular economy principles.

Incorrect

Using Non recyclable materials in production

Not educating consumers on recycling education

Overlooking the economic advantages of adopting circular energy practices.

**Resources question (1.2):** What support, such as funding, regulations, and education, is needed to promote circular energy practices in Europe?

## **Resource cards**

### **Resource Card 1: Financial Resources**

- €15,000 (5 points)
- €60,000 (20 points)
- €120,000 (40 points)

### **Resource Card 2: Technological Know-How - Specific Skills**

- Training to handle complex chemical waste – 10 points
- Training in managing sustainable manufacturing lines – 10 points
- Expertise in creating biodegradable materials - 10 points

### **Resource Card 3: Technological Know-How – Non-Specific Skills**

- Knowledge of advanced recycling methods – 15 points
- Techniques for reducing pollution – 20 points
- Understanding of green chemistry fundamentals - 25 points

### **Resource Card 4: Organizational Know-How - Specific Skills**

- Ability to plan sustainability-focused campaigns – 10 points
- Skills in logistical support for material recovery - 10 points
- Expertise in obtaining government funding for environmental projects – 10 points

### **Resource Card 5: Organizational Know-How – Non-specific Skills**

- Understanding of sustainable business practices – 15 points
- Techniques for community engagement in recycling initiatives – 20 points
- Advanced project management skills for green projects – 25 points

### **Resource Card 6: Mixed Resources**

- €25,000 along with training in handling complex chemical waste – 15 points
- €75,000 for sustainable production line management training – 30 points
- €150,000, and any other selected technical or organizational skill – 50 points

## Challenge cards

### **Challenge card 1 related to Solar Energy and photovoltaic cells:**

Use 2 of your resource cards to design and implement a prototype or pilot project that demonstrates enhanced solar panel efficiency and cost-effectiveness, showcasing its potential for widespread adoption in renewable energy systems.

(Correct answers:

1. Resource Card 1: Financial Resources -

**€120,000 (40 points)**

2. Resource Card 3: Technological Know-How

**Understanding of green chemistry fundamentals - 25 points**

3. Resource Card 2: Technological Know-How - Specific Skills -

**Training in managing sustainable manufacturing lines – 10 points**

4. Resource Card 5: Organizational Know-How – Non-specific Skills -

**Techniques for community engagement in recycling initiatives – 20 points**

These cards will provide the necessary financial backing and technical expertise in green chemistry fundamentals to support your solar panel efficiency project.

This combination leverages expertise in sustainable manufacturing lines management and community engagement techniques, both of which are crucial for implementing a successful solar panel efficiency project with potential for widespread adoption.

**Challenge Card 2 related to renewable energy integration:** You encounter unexpected costs while planning to install wind turbines in your community. Use 2 of the resource cards to mitigate these costs while ensuring the project's sustainability and effectiveness.

**(Resource Card 3: Technological Know-How – Non-Specific Skills**

- Techniques for reducing pollution - 20 points

**Resource Card 5: Organizational Know-How – Non-specific Skills**

- Advanced project management skills for green projects - 25 points

These resource cards provide a total of 45 points, focusing on leveraging skills in pollution reduction techniques and advanced project management to manage unexpected costs in the wind turbine installation project effectively)

**Challenge Card 3 related to chemical testing for safe products:** Think of the chemical safety protocols for a new biofuel production process. Use 2 of your resource cards to ensure the safety of workers and the community, considering potential chemical hazards.

(Possible answers **Resource Card 2: Technological Know-How - Specific Skills**

- **Training to handle complex chemical waste (10 points)**

-Ensure workers are trained to safely handle and dispose of hazardous chemical waste.

**Resource Card 3: Technological Know-How – Non-Specific Skills**

- **Techniques for reducing pollution (20 points)**

- Implement pollution reduction techniques to minimize environmental impact from chemical processes.

**Resource Card 4: Organizational Know-How - Specific Skills**

- **Ability to plan sustainability-focused campaigns (10 points)**

-Develop campaigns to educate and involve the community in safety measures and environmental stewardship.

**Resource Card 5: Organizational Know-How – Non-specific Skills**

- **Advanced project management skills for green projects (25 points)**

-Apply advanced project management skills to ensure effective implementation and monitoring of safety protocols during biofuel production.

**Challenge Card 4 related to Bionergy from organic waste:** Use 2 of your resource cards to optimize the production of biogas from organic waste collected in your neighbourhood. Consider the types of waste, biological processes involved, and community engagement strategies.

1. Resource Card 2: Technological Know-How - Specific Skills

- **Expertise in creating biodegradable materials (10 points)**

Justification: Use expertise in biodegradable materials to enhance the breakdown of organic waste for biogas production.

2. Resource Card 3: Technological Know-How – Non-Specific Skills

- **Knowledge of advanced recycling methods (15 points)**

Justification: Apply advanced recycling methods to optimize organic waste processing for biogas.

3. Resource Card 4: Organizational Know-How - Specific Skills

**- Ability to plan sustainability-focused campaigns (10 points)**

Justification: Plan campaigns to educate and involve the community in separating and recycling organic waste for biogas production.

**4. Resource Card 5: Organizational Know-How – Non-specific Skills**

**- Advanced project management skills for green projects (25 points)** Justification: Utilize advanced project management skills to oversee biological processes and community engagement strategies for sustainable biogas production.)

**Challenge card 5 related to EU Energy Goals:** Use 2 of your resource cards to enhance energy efficiency and integrate renewable energy sources, aligning with EU directives and sustainability mandates.

**(1. Resource Card 1: Financial Resources**

-€120,000 (40 points)

Explanation: Invest in energy-efficient equipment and renewable energy infrastructure upgrades.

**Resource Card 2: Technological Know-How - Specific Skills**

-Training in managing sustainable manufacturing lines (10 points)

**Explanation:** Equipping your team with the necessary skills and knowledge.

**Resource Card 3: Technological Know-How – Non-Specific Skills**

-Techniques for reducing pollution (20 points)

Explanation: Implement pollution reduction techniques to complement energy efficiency efforts.

**Resource Card 5: Organizational Know-How – Non-specific Skills**

Advanced project management skills for green projects (25 points)

**Explanation:** Coordinate renewable energy integration projects effectively to meet EU directives.)

**Player challenge card related to Circular Energy:**

Encourage your team to explore new ways to reuse, recycle, and regenerate energy and materials in your factory. This promotes sustainability and reduces environmental impact.

(Correct answers)

**Resource Card 3: Technological Know-How - Techniques for reducing pollution – 20 points**

Explanation: Enhances capability in minimizing environmental pollution through effective methods.

**Resource Card 4: Organizational Know-How - Skills in logistical support for material recovery - 10 points**

Explanation: - Strengthens logistics to efficiently recover and recycle materials.

**Resource Card 5: Organizational Know-How – Non-specific Skills - Understanding of sustainable business practices – 15 points**

Explanation: – Provides insights for integrating sustainable practices into business operations.

**Resource Card 6: Mixed Resources - €25,000 along with training in handling complex chemical waste – 15 points**

–Supports investment in handling complex chemical waste with financial and training resources.

## **MISSION 5: BASED ON THE TOPIC FROM THE CURRICULUM:(Production of by-design chemicals – renewable energy)**

### **Main Mission Card**

Our mission is to change the chemical industry by encouraging the creation, use, and spread of safe and eco-friendly chemicals made from renewable materials. This will help protect our environment and improve our health.

### **Initial Resources:**

€75,000 as a starting capital

### **Team and equipment:**

- 1 chemical engineer with expertise in sustainable environmental practices, product development, and chemical processes.
- Access to lab spaces with standard analytical tools and apparatus for carrying out research, testing product prototypes, and assessing how their chemical processes affect the environment.
- 3 General Workers

With €75,000 starting capital, your mission is to contribute that the chemical industry is more sustainable by creating and promoting eco-friendly chemicals.

You have 5 facilities located in the same city, green manufacturing facilities. This type of factory focuses on producing eco-friendly products and adopting sustainable practices throughout its operations:

- 1. Recycling used vegetable oil for biodiesel production:** Reducing waste and promoting renewable energy.
- 2. Promotion of eco-friendly household products:** Encouraging sustainable consumer habits.
- 3. Production of bioplastics from renewable materials:** Reducing reliance on traditional plastics and promoting biodegradable alternatives.
- 4. Development of natural dyes from fruits and vegetables:** Offering eco-friendly alternatives to synthetic dyes.
- 5. Production of compostable cutlery from cornstarch:** Providing sustainable options for disposable products.

This is just a brainstorm round of 10 minutes, with a possibility to ask the Game Master a question. There are no points awarded in this round it is just to understand and maybe get a little guidance from the Game master.

Next, we have the secondary mission cards:

## **Secondary Mission Card 1: Production of Bioplastics from renewable materials**

### **Strategy-related Question (1.1)**

How can you create bioplastics using renewable resources like corn starch or sugarcane while minimizing environmental impact?

Correct:

1. Implementing closed-loop recycling systems for bioplastic waste.
2. Collaborating with local farmers for sustainable sourcing of raw materials.
3. Exploring and choosing renewable feedstocks, such as sugarcane or maize starch.

Incorrect:

1. Using complex chemical processes that generate hazardous waste.
2. Do not include stakeholders in the supply chain
3. producing bioplastics with chemicals derived from petroleum.

Resources Question (1.2):

What resources, such as industrial-scale equipment and funding, are needed to produce and distribute bioplastics from starch effectively?

## **Secondary Mission Card 2: Production of Biodiesel from Used Vegetable Oil**

### **Strategy-related Question (1.1):**

What chemical processes can you use to convert waste vegetable oil into biodiesel, promoting renewable energy in transportation?

Correct:

1. Filtering and purifying used vegetable oil before conversion.
2. Testing biodiesel for quality and compliance with fuel standards.
3. Transesterification process using methanol and a catalyst.

Wrong:

1. Using chemical additives that increase emissions.
2. Reacting vegetable oil directly with sulfuric acid to produce biodiesel.
3. Burning vegetable oil directly in diesel engines.

Resources Question (1.2):

What resources, including industrial equipment and partnerships, are necessary to efficiently produce and distribute biodiesel from used vegetable oil?

## **Secondary Mission Card 3: Promotion of Eco-friendly Household Products**

### **Strategy-related Question (1.1):**

How can sustainable chemistry techniques be integrated into the research and promotion of environmentally friendly goods with smaller chemical footprints?

Correct:

Implementing eco-labeling to distinguish sustainable products.

Educating consumers about the environmental benefits of eco-friendly choices.

Conducting life-cycle assessments to verify sustainability claims.

Wrong

Introducing terminology such as "natural" and "green" without providing evidence to support it

Emphasizing recyclability without considering the environmental impact of production.

Highlighting energy efficiency without addressing other environmental aspects.

Resources Question (1.2):

What resources, such as consumer education programs and partnerships with retailers, are necessary to promote and distribute eco-friendly household products effectively?

#### **Secondary Mission Card 4: Implementation of Renewable Energy Sources in Manufacturing**

Strategy-related Question (1.1):

How can your factory motivate the adoption of renewable energy sources in manufacturing processes to decrease carbon emissions?

Correct:

Installing solar panels or wind turbines to generate on-site renewable energy.

Partnering with local providers to purchase sustainable energy.

Engaging employees in energy-saving initiatives through training and awareness.

Wrong:

Overestimating returns from renewable projects.

Assuming significant cost savings from efficiency improvements.

Putting short-term expenses ahead of investments in sustainable energy.

Resources Question (1.2):

What resources, including solar panels, wind turbines, and government grants, are needed to implement renewable energy sources in manufacturing efficiently?

#### **Secondary Mission Card 5: Development of Natural Dyes from Fruits and Vegetables**

Strategy-related Question (1.1):

What methods can you use to extract and produce natural dyes from fruits and vegetables, applying green chemistry principles?

Correct:

Extracting pigments using environmentally friendly solvents.

Implementing waste reduction strategies in the dyeing process.  
Testing the toxicity and color fastness of dyes.

Wrong:

Using synthetic chemicals for dye extraction.

Ignoring regulations on chemical usage in textile manufacturing.

Focusing on aesthetic properties

**Resources Question (1.2):**

What resources, such as extraction technologies and collaboration with local farmers, are necessary to produce and distribute natural dyes from fruits and vegetables effectively?

**Secondary Mission Card 6: Production of Compostable Cutlery from Cornstarch**

**Strategy-related Question (1.1):**

How can you manufacture compostable cutlery from cornstarch, focusing on biodegradability and sustainable chemical production?

Correct

Using non-GMO cornstarch as a raw material.

Testing cutlery for compostability and biodegradability.

Implementing closed-loop systems for waste collection and recycling.

Wrong

Using non-renewable energy sources in production.

Incorporating exotic natural dyes with high environmental impact.

Focusing on biodegradable cutlery without considering product durability.

**Resources Question (1.2):**

What resources, including manufacturing equipment and distribution networks, are needed to produce and distribute compostable cutlery from cornstarch effectively?

## **Resource Cards**

### **Resource card 1: Money**

- Industrial-scale equipment for bioplastic production: €15,000 for 5 points
- Funding for research and development of bioplastic technology: €60,000 for 20 points
- Distribution networks and partnerships for bioplastic distribution: €120,000 for 40 points

### **Resource Card 2: Technological Know-How - Specific**

- Competence in handling complex chemical waste: 10 points
- Training in sustainable manufacturing line management: 10 points
- Expertise in bioplastic production techniques: 10 points

### **Resource Card 3: Technological Know-How – Non-Specific**

- General competence with cutting-edge recycling methods: 15 points
- Modern techniques for reducing pollution: 20 points
- Knowledge of the fundamentals of green chemistry: 25 point

### **Resource Card 4: Organizational Know-How - Specific**

- Creating a sustainability-focused public relations campaign: 10 points
- Logistical expertise for effective material recovery and recycling: 10 points
- Ability to navigate frameworks for certifications of sustainable products: 10 points

### **Resource Card 5: Organizational Know-How – Non-specific**

- General understanding of sustainable business management: 15 points
- Techniques for engaging the community to support sustainable product initiatives: 20 points
- Advanced project management abilities for green projects: 25 points

### **Resource Card 6: Mixed resources**

- €25,000 and training in renewable energy integration – 15 points
- €75,000 sustainable production line management training -25 points
- €150,000 and expertise in green chemistry principles – 40 points

## Challenge Card 1

The objective assigned to your group is to maximize the bioplastics manufacturing process by utilizing sustainable materials like sugarcane or maize starch. Use 2 of your resource cards to ensure that the production is as cost-effective as possible while minimizing the impact on the environment.

Correct:

**Resource Card 1:** Funding for research and development of bioplastic technology (€60,000 for 20 points)

- Allocate funds towards enhancing bioplastic production techniques, ensuring efficiency and environmental compatibility.

**Resource Card 2:** Expertise in bioplastic production techniques (10 points)

- Utilize specialized knowledge to optimize bioplastic manufacturing processes using sustainable materials like sugarcane or maize starch.

**Resource Card 3:** Knowledge of the fundamentals of green chemistry (25 points)

- Apply green chemistry principles to refine bioplastic production, minimizing environmental impact through chemical process improvements.

**Resource Card 6:** €150,000 and expertise in green chemistry principles (40 points)

- Invest in advanced green chemistry expertise to develop bioplastic formulations that are both sustainable and cost-effective.

## Challenge Card 2

Your team's mission is to optimize the production of biodiesel from used vegetable oil to promote renewable energy in transportation. Use 2 of your resource cards to ensure the process is efficient, cost-effective, and environmentally sustainable.

### Possible answers

#### Resource Card:

1. Resource Card 1: Funding for research and development of biodiesel technology (€60,000 for 20 points)
  - Provide funding for studies aimed at improving the environmental friendliness and efficiency of biodiesel production.
2. Resource Card 2: Expertise in biodiesel production techniques (10 points)
  - Optimize chemical procedures for the generation of biodiesel from used vegetable oil.
3. Resource Card 3: Knowledge of the fundamentals of green chemistry (25 points)

- Refine biodiesel production processes using the concepts of green chemistry to cut down on emissions and chemical waste.
4. Resource Card 4: Logistical expertise for effective material recovery and recycling (10 points)
- Put into practice effective logistical techniques for collecting and turning used vegetable oil into biodiesel.

### **Challenge Card 3**

The goal of your team's research is to integrate sustainable chemistry methods into household items that are less harmful to the environment and have lower chemical footprints. Use two of your resource cards to promote these goods and encourage customers to make sustainable decisions.

#### **Resource Card 1: Money**

- Industrial-scale equipment for bioplastic production: €15,000 for 5 points

This card is in favour of increasing the manufacturing of bioplastics, which is essential for creating effectively sustainable household products.

#### **Resource Card 2: Technological Know-How - Specific**

- Expertise in bioplastic production techniques: 10 points

This card is in favour of increasing the manufacturing of bioplastics, which is essential for creating effectively sustainable household products

#### **Resource Card 3: Technological Know-How – Non-Specific**

- Knowledge of the fundamentals of green chemistry: 25 points

Essential for ensuring that household items are developed using environmentally friendly chemistry principles, minimizing ecological impact.

#### **Resource Card 6: Mixed resources**

- €150,000 and expertise in green chemistry principles: 40 points

Offers significant financial support and expert knowledge in green chemistry, both of which are essential for creating environmentally friendly and highly efficient sustainable household products.

### **Challenge Card 4**

Your objective is to enhance the integration of renewable energy sources such as solar and wind into your manufacturing operations. Utilise two of your resource cards strategically to achieve this goal effectively.

### **Resource Card 1: Money**

- Funding for research and development of bioplastic technology: €60,000 for 20 points

This card offers significant funds dedicated to the advancement of bioplastic technology—a critical component of sustainable manufacturing methods.

### **Resource Card 3: Technological Know-How – Non-Specific**

- Knowledge of the fundamentals of green chemistry: 25 points

This card provides knowledge of green chemistry, which is important for creating environmentally friendly chemical processes in production.

### **Resource Card 6: Mixed resources**

- €75,000 sustainable production line management training: -25 points

This card offers financing and training, in order to improve production line management in a sustainable manner and raise overall efficiency and sustainability,

### **Resource Card 5: Organizational Know-How – Non-specific**

- Techniques for engaging the community to support sustainable product initiatives: 20 points

**Reasoning:** This card focuses on community engagement strategies, which are essential for successfully supporting and promoting programs involving sustainable products.

### **Challenge Card 5**

Your objective is to innovate in the extraction and production of natural dyes from fruits and vegetables, focusing on minimizing chemical waste and maximizing environmental sustainability. Use 2 of your resource cards to achieve this goal effectively.

Correct:

#### 1. Resource Card 3: Technological Know-How – Non-Specific

- Modern techniques for reducing pollution: 20 points

To implement sustainable methods in dye extraction processes, minimizing environmental impact.

#### 2. Resource Card 4: Organizational Know-How - Specific

- Logistical expertise for effective material recovery and recycling: 10 points

-To ensure efficient handling of waste materials from natural dye production, promoting recycling.

### 3. Resource Card 5: Organizational Know-How – Non-specific

- Techniques for engaging the community to support sustainable product initiatives: 20 points

To foster community involvement and support for natural dye products, enhancing sustainability efforts.

### 4. Resource Card 6: Mixed resources

- €25,000 and training in renewable energy integration – 15 points

To explore renewable energy solutions for powering processes related to natural dye production, reducing carbon footprint.

## **Player Challenge Card 6**

Challenge the opposing side the task of conducting a sustainability audit of their manufacturing operations, emphasizing waste reduction tactics, energy efficiency, and environmental effect evaluations. Use 2 of your resource cards.

### 1. Resource Card 2: Technological Know-How - Specific

- Training in sustainable manufacturing line management:

During the audit, this resource card will assist in enhancing sustainability and energy efficiency procedures.

### 2. Resource Card 3: Technological Know-How – Non-Specific

- Modern techniques for reducing pollution

During the sustainability audit, using these methods will help in finding and putting into practice pollution reduction solutions.

### 3. Resource Card 4: Organizational Know-How - Specific

- Logistical expertise for effective material recovery and recycling:

Using this card will make it possible to apply effective recycling and waste management techniques all during the audit process.

### 4. Resource Card 6: Mixed resources

- €25,000 and training in renewable energy integration:

This resource will facilitate the integration of renewable energy sources into manufacturing processes, enhancing energy efficiency during the audit.)

## **MISSION 6: BASED ON THE TOPIC FROM THE CURRICULUM:**

(A strengthened chemical science-policy interface (concept of circular economy))

### **Main Mission Card**

**Mission:** Improve your chemical company by following the EU's chemical safety and sustainability steps.

#### **Initial Resources:**

- €50,000 as a starting capital

#### **Team**

**1 Environmental Science Specialist:** Has expertise in sustainable practices, product development, and chemical processes. Guides the team in understanding environmental impacts and implementing sustainable solutions.

**3 Team Members:** Students or participants who assist in research, data collection, and project implementation under the guidance of the environmental science specialist.

#### **Equipment:**

- **Access to School Laboratory:** Equipped with standard analytical tools such as spectrophotometers, pH meters, and balances.
- **Lab Apparatus:** Includes glassware (beakers, flasks), safety equipment (goggles, gloves), and basic chemical reagents for conducting experiments.
- **Computer with Software:** For data analysis, modeling chemical processes, and preparing presentations.

Students will not only deepen their knowledge but also actively contribute to addressing real-world challenges in strengthening science-policy interface, and environmental sustainability within the EU context. They will discuss about all necessary resources (money, technical skills, and organizational skills/actions) needed to achieve the main mission by answering the secondary mission cards, and they use these points to obtain resource cards that support their strategic plans and facilitate their progress toward achieving the game's goals.

This is just a brainstorm round of 10 minutes, with a possibility to ask the Game Master a question. There are no points awarded in this round it is just to understand and maybe get a little guidance from the Game master.

## Secondary Mission Cards:

### 1. Hazardous Chemicals Reduction

**Strategy Question:** How can we systematically evaluate and phase out hazardous chemicals from our production processes without compromising product quality?

Correct

By conducting chemical Hazard Assessment

By creating safer chemicals and reducing waste without sacrificing functionality.

By ensuring compliance to laws on chemical use and disposal.\

Wrong:

Assuming biodegradable means safe

Choosing cheaper alternatives

Relying just on green marketing claims

**Resource Question:** Where can we find case studies or success stories from other companies that have successfully transitioned to safer chemical alternatives?

### 2. Accurate Labeling

**Strategy Question:** What procedures can we implement to ensure accurate and compliant labeling of our chemical products?

Correct:

Collaborate with experts to remain up to date on label specifications.

Use technology to increase accuracy and decrease mistakes.

Keep thorough records of your labeling procedures.

Wrong:

Implementing labeling rules uniformly and without modification in various markets.

Relying solely on visual evaluations without conducting official reviews.

Trusting external suppliers' labels are complaint.

**Resource Question:** Which regulatory websites or industry guidelines provide comprehensive information on chemical labeling standards and requirements?

### 3. Innovation and Research

**Strategy Question:** How can we foster innovation within our company to develop new, sustainable chemical products or processes?

Correct

Encourage staff members to spearhead and suggest sustainable projects.

Integrate circular economy ideas into the creation and design of new products.

Utilize internet channels to collect creative concepts from a worldwide audience.

Wrong

Only managers can provide input on new projects.

Avoid learning from the long-term innovations of your rivals.

Apply unchanging procedures to all R&D projects

**Resource Question:** What industry conferences or research institutions can we collaborate with to stay updated on advancements in sustainable chemistry?

#### **4. Plastic Waste Minimization**

**Strategy Question:** What initiatives can we implement to minimise plastic waste in our manufacturing and packaging processes?

Correct

Raw materials should be stored and transported in reusable containers.

Review and evaluate plastic usage on a regular basis to find areas for decrease.

Implement a mechanism for recycling manufacturing-used plastics.

Wrong

Make plastic packaging thicker

Develop a method for managing waste by burning plastic.

Prioritize end-of-life disposal without making any reductions:

Resource Question: How can we partner with recycling companies or environmental consultants to optimize our plastic waste management practices?

#### **5. Carbon Emissions Reduction**

Strategy Question: What strategies can we adopt to reduce carbon emissions throughout our supply chain and operations?

Correct

Obtain materials locally

Upgrade your equipment to use less energy.

Power operations with renewable energy like solar or wind.

Wrong

More dependence on fossil fuels

Postpone implementing energy-saving measures

Growing business without doing environmental impact assessments

Resource Question: Where can we find tools or software to calculate and track our company's carbon footprint accurately?

## 6. Team Education and Advocacy

**Strategy Question:**How can we educate and empower our employees to prioritize sustainability and advocate for green practices within our company?

Correct

Supporting Employee-led Sustainability Projects

Integrating Sustainability into Performance Reviews:

Incentives for Green Initiatives

Wrong

Enforcing Adherence to green practices Without Assistance

Promoting greenwashing

Punishing workers for changes in the price of sustainable materials.

**Resource Question:** What online courses or training modules are available to enhance our team's understanding of sustainable chemistry principles and practices?

### Resource Card 1: Financial Resources

- Access to grants or funding opportunities up to €50,000 for research and development of safer chemical alternatives for 25 points
- Budget allocation up to €30,000 for implementing hazardous chemicals reduction strategies: for 20 points
- Partnership with venture capitalists interested in sustainable innovations up to €100,000 for 30 points

### Resource Card 2: Technological Know-How - Specific Skills

- Knowledge of advanced recycling methods - 15 points
- Expertise in developing eco-friendly packaging solutions - 20 points
- Capability to utilize 3D printing for sustainable product prototyping - 25 points

### Resource Card 3: Technological Know-How – Non-Specific Skills

- Techniques for reducing pollution - 20 points
- Understanding of energy-efficient manufacturing processes - 15 points
- Familiarity with applications for environmental monitoring - 25 points

### Resource Card 4: Organizational Know-How - Specific Skills

- Experience in implementing ISO standards for chemical safety - 20 points
- Expertise in conducting life cycle assessments (LCA) for product sustainability - 25 points
- Ability to conduct comprehensive environmental impact assessments (EIA) - 30 points

#### **Resource Card 5: Organizational Know-How - Non-Specific Skills**

- Leadership skills for driving sustainability initiatives - 15 points
- Team-building strategies to foster a culture of sustainability - 10 points
- Proficiency in change management for implementing green practices - 20 points

#### **Resource Card 6: Mixed Resources**

- Collaboration with recycling companies for optimizing plastic waste management - 25 points
- Partnerships with regulatory experts to ensure compliance with chemical labeling standards - 20 points
- Access to industry-specific sustainability networks and forums - 30 points

#### **Challenge cards**

##### **1. Chemical Revolution**

**Challenge card 1:** Your recycling plant's main chemical supplier suddenly stops producing a key ingredient due to environmental concerns. Use 2 of your resource cards that will help you propose alternatives quickly that won't affect the quality of your recycling process.

(Correct:

1. Resource Card 1: Access to grants or funding opportunities for research and development of safer chemical alternatives up to 50 000 - 25 points

-It provides financial support essential for exploring and developing safer chemical alternatives through available funding opportunities.

2. Resource Card 4: Ability to conduct comprehensive environmental impact assessments (EIA) - 30 points

- It enables thorough evaluations of environmental impacts, crucial for informed decision-making in sustainability initiatives.

3. Resource Card 2: Expertise in developing eco-friendly packaging solutions - 20 points

- It offers expertise necessary for creating packaging that reduces environmental impact while maintaining functionality.

4. Resource Card 6: Collaboration with recycling companies for optimizing plastic waste management - 25 points. It facilitates effective partnerships aimed at improving plastic waste management practices, crucial for sustainability goals. )

## 2. Labeling Perfection

**Challenge card 2:** Your team discovers that some chemical products were mistakenly labeled with incorrect hazard symbols. Use 2 of your resource cards to implement a robust system to ensure accurate and compliant labeling across all products.

### (Resource Card 1: Financial Resources

- Budget allocation up to €30,000 for implementing hazardous chemicals reduction strategies - 20 points
- 2. **Resource Card 4: Organizational Know-How - Specific Skills**
  - Experience in implementing ISO standards for chemical safety - 20 points
- 3. **Resource Card 6: Mixed Resources**
  - Partnerships with regulatory experts to ensure compliance with chemical labeling standards - 20 points
- 4. **Resource Card 3: Technological Know-How – Non-Specific Skills**
  - Familiarity with applications for environmental monitoring - 25 points

These resource cards offer financial assistance, specialized knowledge of chemical safety standards, partnerships for regulatory compliance, and environmental monitoring abilities—all of which are essential for successfully tackling labeling difficulties.)

## 3. Innovation and Sustainability Leadership

**Challenge card 3:** Your factory faces increased pressure from stakeholders to innovate and lead in sustainable practices. Choose 2 of your resource cards measures that integrates innovative technologies while educating and empowering your team to advocate for green practices within the company

### (Resource Card 2: Technological Know-How - Specific Skills

- Capability to utilize 3D printing for sustainable product prototyping - 25 points
- 2. **Resource Card 3: Technological Know-How – Non-Specific Skills**
  - Techniques for reducing pollution - 20 points
- 3. **Resource Card 4: Organizational Know-How - Specific Skills**
  - Ability to conduct comprehensive environmental impact assessments (EIA) - 30 points
- 4. **Resource Card 5: Organizational Know-How - Non-Specific Skills**
  - Leadership skills for driving sustainability initiatives - 15 points

These resource cards offer the technical expertise, both specialized and general, environmental impact assessment skills, and leadership qualities necessary to stimulate innovation and advance environmentally friendly procedures in your recycling facility.)

## 4. Plastic Waste Reduction

**Challenge card 4:** A group of environmentally conscious students challenge your company to reduce plastic waste in packaging by 50% within six months. Use 2 of your resource cards to come up with creative solutions that maintain product safety and customer satisfaction.

1. Resource Card 2: Technological Know-How - Specific Skills

- **Expertise in developing eco-friendly packaging solutions - 20 points**

2. Resource Card 6: Mixed Resources

- **Collaboration with recycling companies for optimizing plastic waste management - 25 points**

3. Resource Card 1: Financial Resources

- **Budget allocation up to €30,000 for implementing hazardous chemicals reduction strategies - 20 points**

4. Resource Card 3: Technological Know-How – Non-Specific Skills

- **Techniques for reducing pollution - 20 points**

Explanation: These methods, which lessen the impact of packaging waste on the environment, can include developments in biodegradable materials or compostable packaging.

These resource cards address the challenge of minimizing plastic waste in packaging while upholding operational standards and customer satisfaction. They do this by combining technological expertise, financial support, collaborative opportunities, and environmental measures.)

## **5. Carbon Footprint solutions**

**Challenge card 5:** New government regulations require your recycling plant to significantly cut down on carbon emissions. Use 2 of your resource goals to fulfill these goals while keeping operations running smoothly.

Correct answers:

**1. Resource Card 2: Knowledge of advanced recycling methods - 15 points**

**2. Resource Card 6: Collaboration with recycling companies for optimizing plastic waste management - 25 points**

**3. Resource Card 3: Understanding of energy-efficient manufacturing processes - 15 points**

**4. Resource Card 4: Experience in implementing ISO standards for chemical safety - 20 points**

With the help of these resource cards, the recycling plant can effectively reduce carbon emissions as mandated by new government regulations by implementing cutting-edge recycling techniques, maximizing plastic waste management through collaborative efforts, adopting energy-efficient manufacturing processes, and ensuring compliance with ISO standards.

## **Player Challenge Card**

Challenge the opposing team to Use 2 of their resource cards for comprehensive sustainability plan for their manufacturing operations, focusing on reducing environmental impact, enhancing resource efficiency, and promoting green practices throughout their supply chain

(1. Financial Resources

**- Partnership with venture capitalists interested in sustainable innovations up to €100,000 for 30 points**

2. Technological Know-How - Specific Skills

**- Capability to utilize 3D printing for sustainable product prototyping - 25 points**

3. Technological Know-How – Non-Specific Skills

**- Familiarity with applications for environmental monitoring - 25 points**

4. Organizational Know-How - Specific Skills

**- Ability to conduct comprehensive environmental impact assessments (EIA) - 30 points**

These resource cards were selected in order to guarantee a comprehensive sustainability plan that makes use of funding for creative solutions, cutting-edge technology for sustainable prototyping, proficiency with environmental monitoring, and the capacity to carry out exhaustive environmental impact assessments to direct efficient green practices.