



ECO CITY

SERIOUS GAME IN UNITY 3D



POLITECNICO
MILANO 1863

DIPARTIMENTO DI ELETTRONICA
INFORMAZIONE E BIOINGEGNERIA

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INTRODUCTION

Climate change stands as one of the most pressing and relevant challenges of our time.

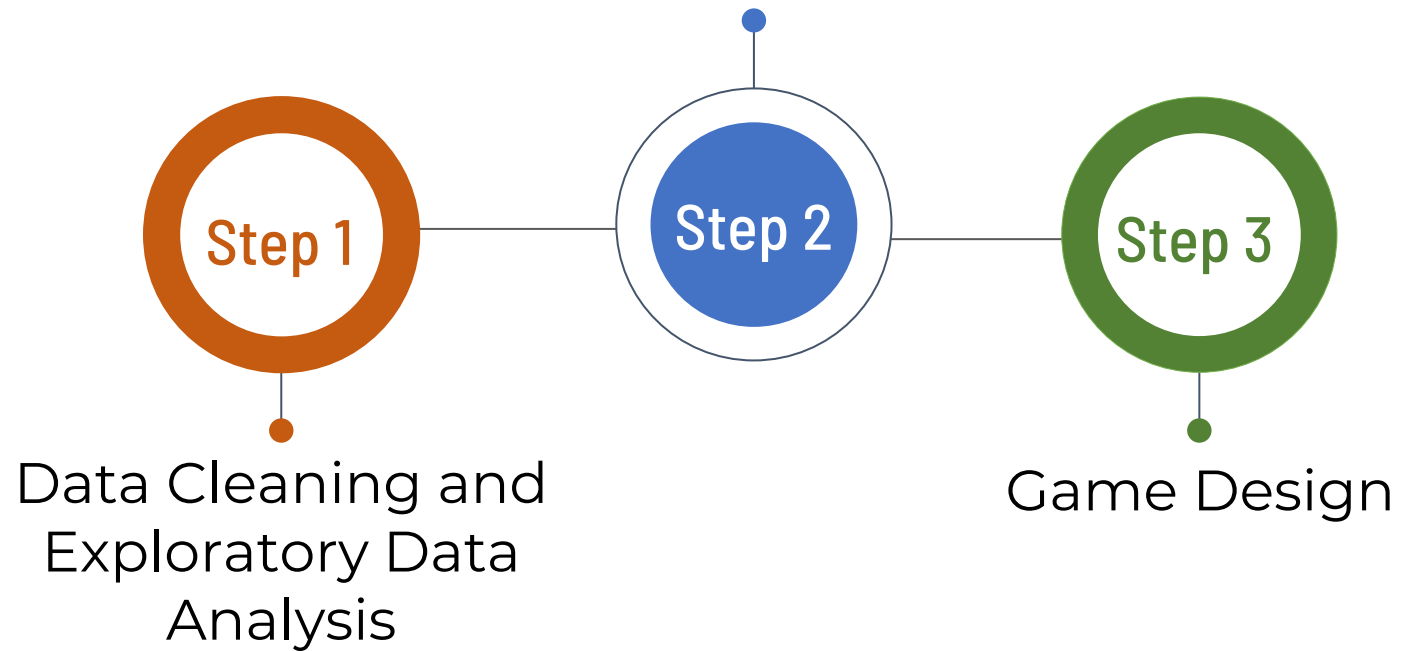
Despite overwhelming scientific evidence connecting it to human activities, skepticism and ongoing debate endure.

Objectives

- 01** Develop an interactive game using Unity 3D, offering an engaging and highly personalised learning experience
- 02** Inform players about the consequences of their daily actions, inspiring them to embrace more sustainable and conscious behaviours

WORKFLOW

Personas Creation



DATA CLEANING

Step 1

Feature Selection

Selection of **30 features**:

- 5 features of general information
- 13 features of Eco-anxiety
- 12 features of Skepticism

Gathered from 160 dimensions

- Affective Symptoms
- Behavioural Symptoms
- Anxiety Personal Impact

Reverse the scores of
specific columns

Handle Missing Data

- 'Age' feature
- 'Education' feature

Fill in the **mean value** of their
respective column to preserve more

- Attribution Skepticism
- Impact Skepticism
- Trend Skepticism
- Response Skepticism

Features Creation

Extraction and grouping of specific
columns into new **features**.

Step 2

Step 3

EXPLORATORY DATA ANALYSIS

Step 1

Step 2

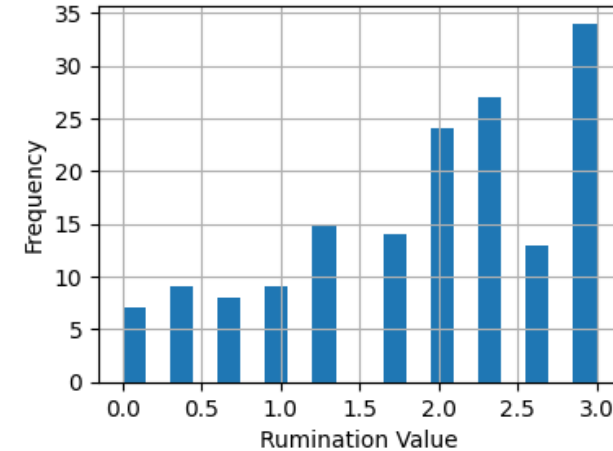
Step 3

01 UNIVARIATE ANALYSIS

Use of

- Histograms
- Box Plots

To visualize the distribution of each feature and check for outliers



02 BIVARIATE ANALYSIS

To assess the correlation between features

- **Numerical features**

- Pearson's coefficient
- Heatmap



'Age' and 'Income' are poorly correlated

- **Categorical features**

- Contingency tables
- Fisher test in R



Good correlation among features

PERSONAS CREATION: CLUSTERING

Step 1

Tested three different **clustering algorithms**:

- K-means clustering
- DBScan clustering
- **Hierarchical clustering**

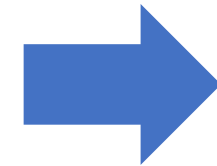
Step 2

Evaluated through analysis of:

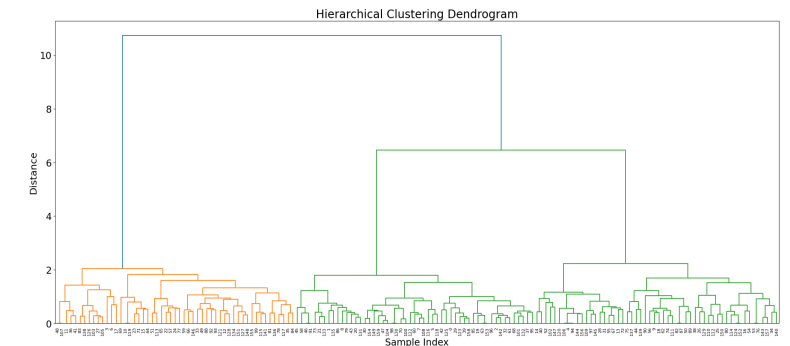
- Knee-elbow analysis
- Inconsistency
- **Silhouette**

Step 3

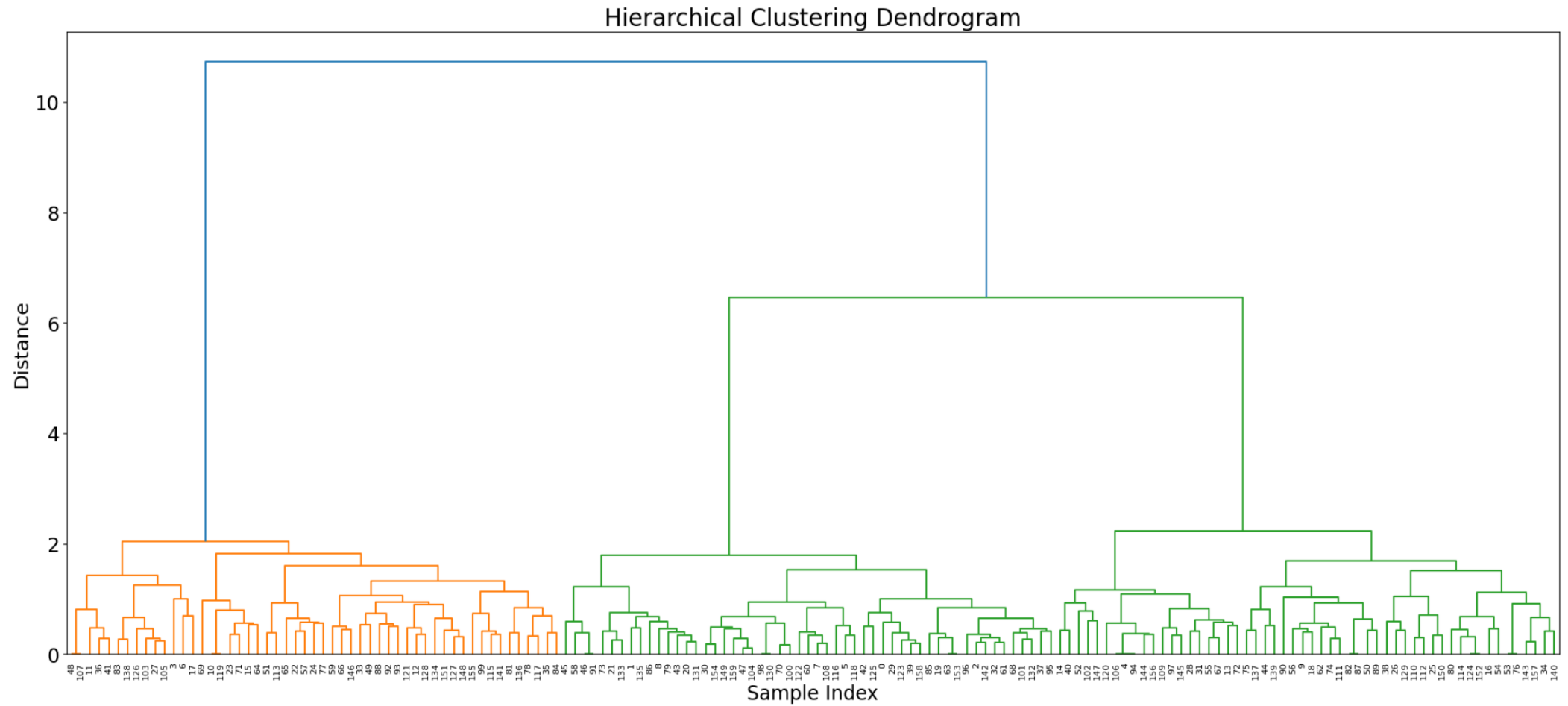
for both standardized and normalized data



3 clusters with
normalized data



PERSONAS CREATION: CLUSTERING



PERSONAS CREATION: STATISTICAL ANALYSIS

Numerical Variables

- Kruskal-Wallis test: across groups
- Kruskal-Wallis and Mann Whitney U: paired group

Categorical Variables

- Chi-Square Test → rule of 5 or more
- Fisher Test in Python → 2x2 contingency tables
- Fisher Test in R → larger contingency tables

Step 1

Step 2

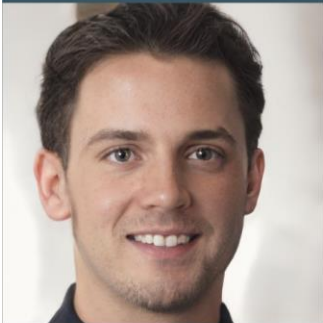
Step 3

	Group 1 (n=53)	Group 2 (n=53)	Group 3 (n=54)	P value
Age	19 (13.2%)	42 (11.3%)*	42 (14.8%)*	<0,001
Education	18 (34%)	8 (45.3%)*	13 (57.4%)*#	<0,001
Income	33000 (11.3%)	21000 (9.4%)*	29000 (11.1%)#	<0,001
Attribution Skepticism	1 (26.4%)	3 (34%)*	2.7 (31.5%)*#	<0,001
Impact Skepticism	0.3 (26.4%)	3 (39.6%)*	0.3 (29.6%)#	<0,001
Trend Skepticism	1.3 (30.2%)	3.3 (30.2%)*	2 (33.3%)*#	<0,001
Affective Symptoms	0.8 (20.8%)	3 (43.4%)*	2 (18.5%)*#	<0,001
Rumination	0.3 (17%)	3 (50.9%)*	2 (29.6%)*#	<0,001
Behavioural Symptoms	1.7 (18.9%)	3 (67.9%)*	2 (31.5%)*#	<0,001
Anxiety Personal Impact	1 (18.9%)	3 (60.4%)*	2 (27.8%)*#	<0,001

We removed '**Gender**,' '**Marital status**,' and '**Response Skepticism**', as the statistical analysis revealed their lack of significance in cluster diversification

PERSONAS CREATION: PERSONA CARDS

Marco



"Growing personally, fostering wellness, and sowing seeds of change in the rhythm of Milan."

Age: **19**
Work: **Student**
Gender: **Male**
Family: **Single**
Location: **Milan, Italy**
Character: **Thoughtful, Proactive**

Goals

- Education and skill development
- Health and wellness
- Environmental and social awareness

Frustrations

- Uncertainty about the future
- Global concerns
- Limited resources

Bio

Marco is a 19-year-old student living in the vibrant city of Milan, whose journey is guided by a commitment to personal growth, health and wellness, as well as environmental and social awareness. Marco's proactive and thoughtful nature sets him apart in the vibrant urban landscape. In the heart of Milan, Marco has embraced the city's energy while nurturing his own path of personal development. Eager to expand his horizons, he pursues educational opportunities that align with his passion for sustainability and social responsibility. As a proactive advocate for change, Marco has engaged in local environmental initiatives, driving awareness on issues like climate change and waste reduction. While navigating the challenges of adolescence and the complexities of a modern metropolis, Marco's journey is defined by a harmonious blend of personal aspirations and a genuine concern for the world around him.

Personality

Introvert	Extrovert
Thinking	Feeling
Skeptical	Undoubting
Anxious	Calm

Goals

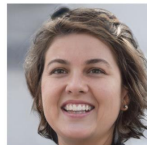
Motivation

Incentive	
Fear	
Growth	
Power	
Social	

Preferred Channels

Traditional Ads	
Online & Social Media	
Referral	

Anita



"Navigating life's journey, and reaching for success on my own terms."

Age: **42**
Work: **Cashier**
Gender: **Female**
Family: **Married**
Location: **Nurri, Italy**
Character: **Talkative, impulsive**

Goals

- Having a big family
- Become the chief of the supermarket
- Financial stability

Frustrations

- Escaping government controlled society
- Fear of losing the job

Bio

Anita, a resilient soul navigating the intricacies of a small town life, was born and raised in the tight-knit community of Nurri, Sardinia. Anita developed a keen interest in unraveling mysteries from an early age. Her journey as a cashier at the local grocery store not only reflects her dedication to the community but also serves as a front-row seat to the diverse array of characters populating the town. Her inquisitive mind, combined with an innate ability to connect with people, has turned her into an unintentional confidante for many in Nurri. Despite her seemingly unshakable exterior, Anita struggles with frequent episodes of anxiety, particularly related to the changing dynamics within the town and the environmental challenges that affect its residents.

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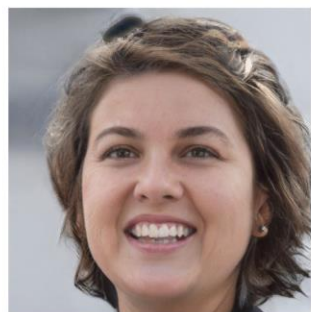
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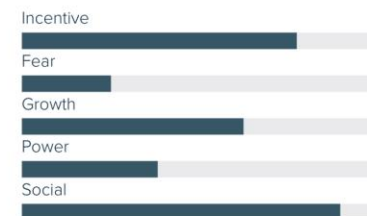
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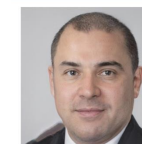
Motivation



Preferred Channels



Daniele



"Working hard, embracing change, and finding new purposes are the keys to endurance"

Age: **42**
Work: **Sales Manager**
Gender: **Male**
Family: **Widowed**
Location: **Pisa, Italy**
Character: **Contemplative**

Personality



Goals

- Provide a radiant future for his daughter
- Community Engagement
- Personal Growth

Frustrations

- Fear of isolation
- Inadequacy in addressing climate change.

Bio

Daniele's life took an unexpected turn when he tragically lost his wife in a car accident. Suddenly thrust into the role of a single parent, he found himself navigating the challenges of raising a 5-year-old daughter on his own. Wobbling but not defeated, he carries with him the lessons of love and loss.

As a seasoned sales manager, Daniele approaches both his professional and personal life with a blend of tenacity and compassion. Balancing the demands of the corporate world with the responsibilities of a single parent, he is a testament to strength in adversity.

Daniele is an informed individual, and as such, he is aware of the current issues related to climate change. In his own way, he tries to make an effort not to contribute further harm to the environment. However, he remains uncertain whether his actions truly carry weight in addressing the global problem, which contributes to raise his occasional moments of stress and anxiety.

Daniele's journey is a story of perseverance, adapting to change, and finding new purpose in the face of life's challenges.

Motivation



Preferred Channels



PERSONAS CREATION: PERSONA CARDS

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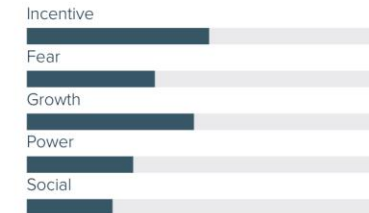
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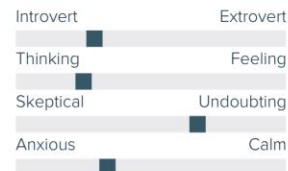
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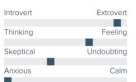
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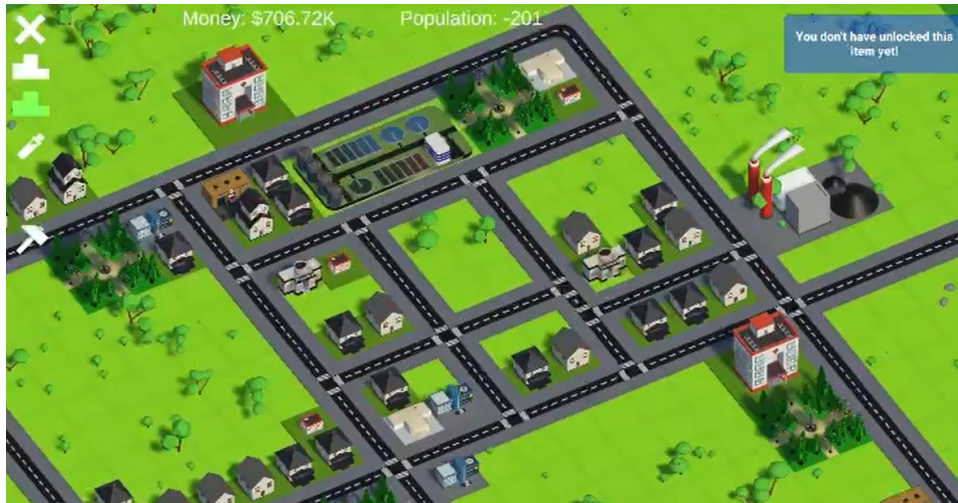
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GAME DESIGN

Step 1

Step 2

Step 3



In this sandbox-style game, players **construct** and **manage** a virtual city through Game Money:

- navigating sustainability challenges,
- unlocking structures via quizzes,
- addressing climate change indicators



AUDIENCE

Individuals aged 16 and above looking for an engaging educational experience on climate change

GAME DESIGN

Step 1

Step 2

Step 3

To initiate gameplay, the user is required to respond to a **questionnaire**



Allows the determination of the player's **cluster association**, leading to the activation of a tailored edition of the game



GAME DESIGN



Energy Production

- Solar Power
- Wind Turbine
- Nuclear Power Plant
- Carbon Power Plant

Entertainment

- Cinema
- Restaurant
- Bar
- Shop

Industries

- Factory
- Crop



Residence

- House
- High-Density House

Public Services

- Hospital
- Clinic
- Fire Station
- University
- Police Station
- Park

Water Distribution

- Water Plant

GAME DESIGN: QUIZ

Start building the city with the
basic structures



Periodic random **quizzes** relative to
climate change for are proposed

Step 1

Step 2

Step 3

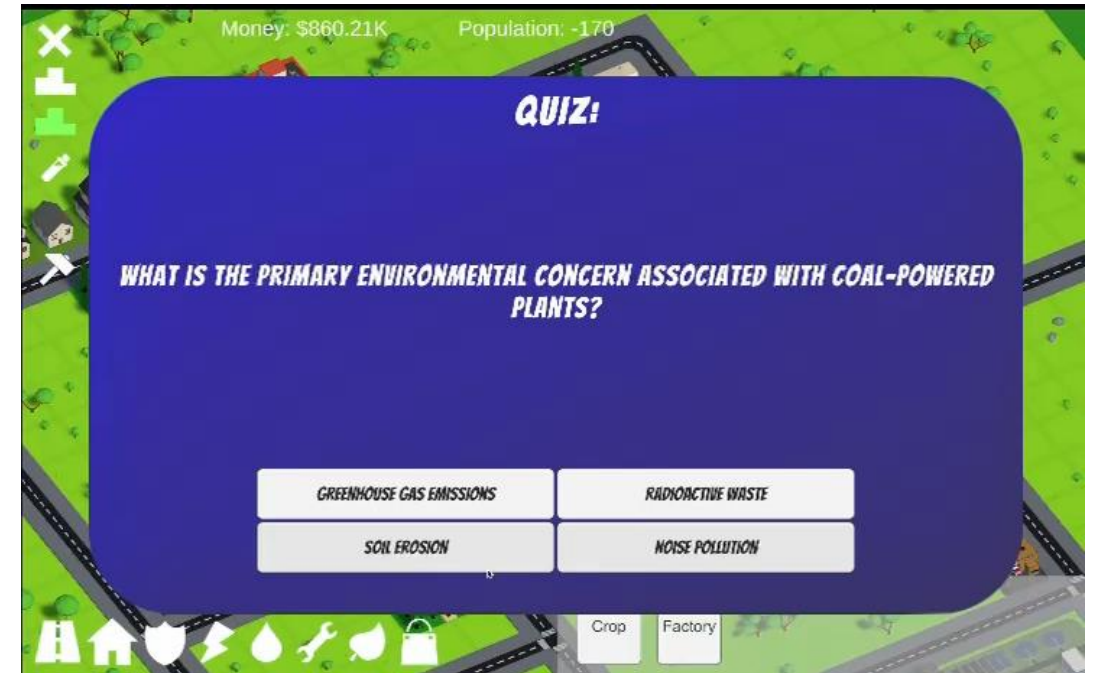


Retry the
quiz after
some time



Unlock the
corresponding
building

An explanation of the correct
answer is provided



GAME DESIGN: RESEARCH



Building a university allows
unlocking **scientific research**



Conducting targeted research on
innovative energy sources enhances the
efficiency of industries associated with
that specific energy type



The user needs to plan what technology to
research based on their needs

GAME DESIGN: STATISTICS AND INDICES



Utilizing **statistics** and **environmental indices** enables the monitoring of the city's state



Construction of structures based on the city's requirements



Need to consider the Game Money available

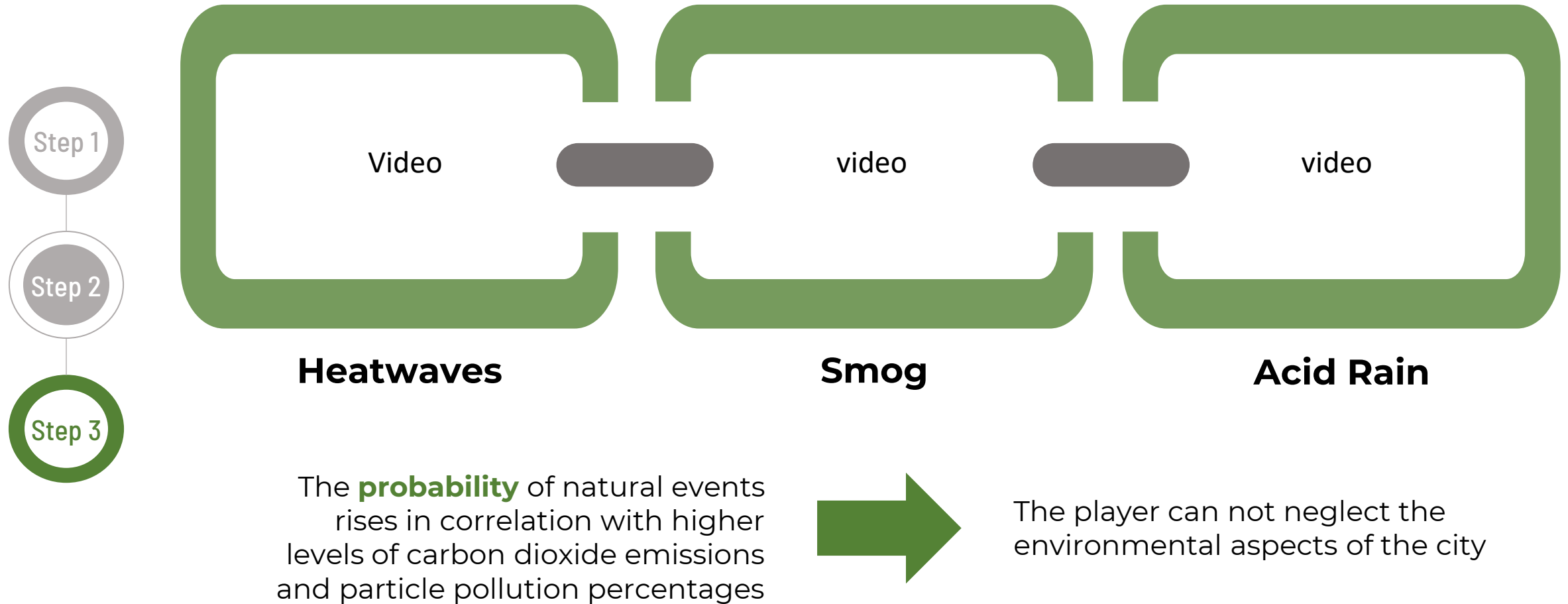
City Statistics

- Employment
- Energy Ratio
- Jobs occupied
- Criminals Covered
- Patients Covered

Environmental Indices

- Particle Pollution
- Carbon Dioxide

GAME DESIGN: NATURAL EVENTS



GAME DESIGN: PERSONALIZATION



Eco-Anxiety

Influence the probability
of natural events



Higher Eco-Anxiety



Lower Probability

Skepticism

Influence the impact of
particle pollution and
carbon dioxide emissions



Higher Skepticism



Higher Impact

GAME DESIGN



The objective is not to achieve a specific victory; rather, it is to **continually expand** and **prosper** the city

Losing condition: if the player sustains **negative Game Money** for over 60 consecutive seconds.

FUTURE DEVELOPMENT

01

Different Starting Conditions

Provide players with different initial scenarios, offering a more dynamic and immersive experience, reflecting the complexity of climate change challenges

02

Saving the Game

Allow users to save and resume their gameplay, promoting a more flexible and user-friendly experience

03

Different Win/Lose Conditions

Introduce a competitive element by establishing diverse win-and-lose conditions. Create a ranking system, fostering healthy competition among players

04

Add more Objectives for Finalization Customization

Expand the range of objectives for a more customized and personalized gameplay experience