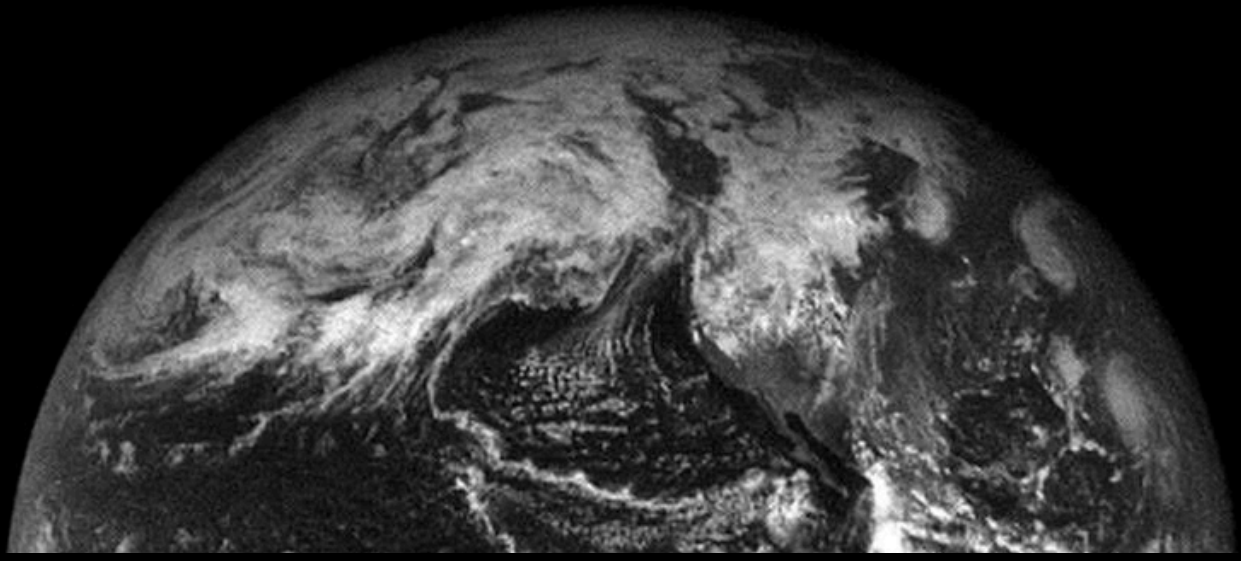
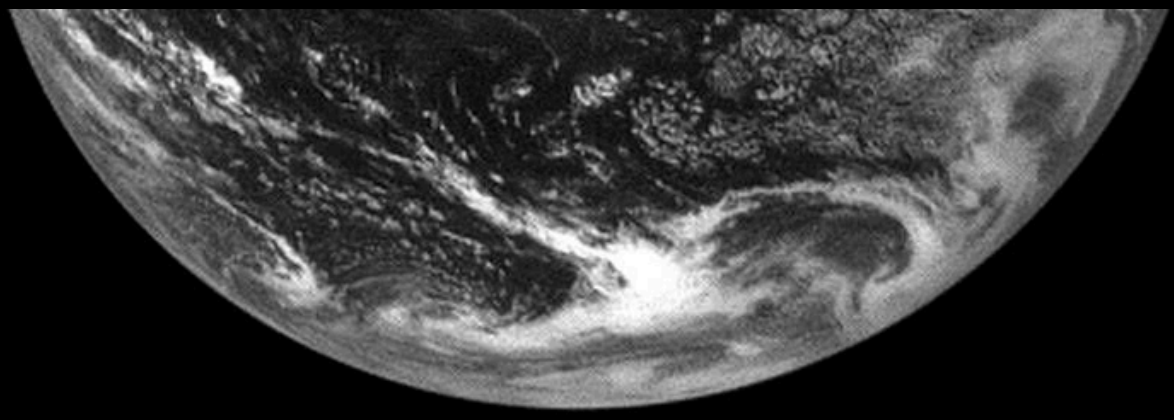
SMART DÚN LAOGHAIRE
A Smart Dublin District

Amber Desprets

2023-2024



IMAGINE THE IMPACT



A collection of images of the future created by 5 curious students during the second iteration of the Trendhunters engagement programme.

Dublin, Ireland

dlr Comhairle Contae County Council
CONNECT SFI Research Centre for Future Networks
Trinity College Dublin Coláiste na Tríonóide, Baile Átha Cliath The University of Dublin
SFI Science Foundation Ireland

“JUST AS A MIRROR REFLECTS MORE LIGHT WHEN BROKEN, THE FUTURE IS FELT MORE WHEN IT IS SPECULATED ABOUT.”

- AMBER DESPRETS

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Welcome to our imagination

Dearest reader.

We are delighted to extend an invitation to you. Not to visit the future, but to envision it. You are invited to imagine the impact of everything that is mentioned in this report. Whether it's an innovation, a fact, an event, a potential consequence or a scenario. The future is supposed to be felt and what better way to feel it than through vivid imagination?

This report is not meant to tell you what is going to happen. No one possesses the power to predict the future and neither do the contributers of this report. This report is meant to be thought-provoking. To be discussed. To be challenged in future conversations. And hopefully to be referred to when others are navigating uncertainty and are in need of perspectives.

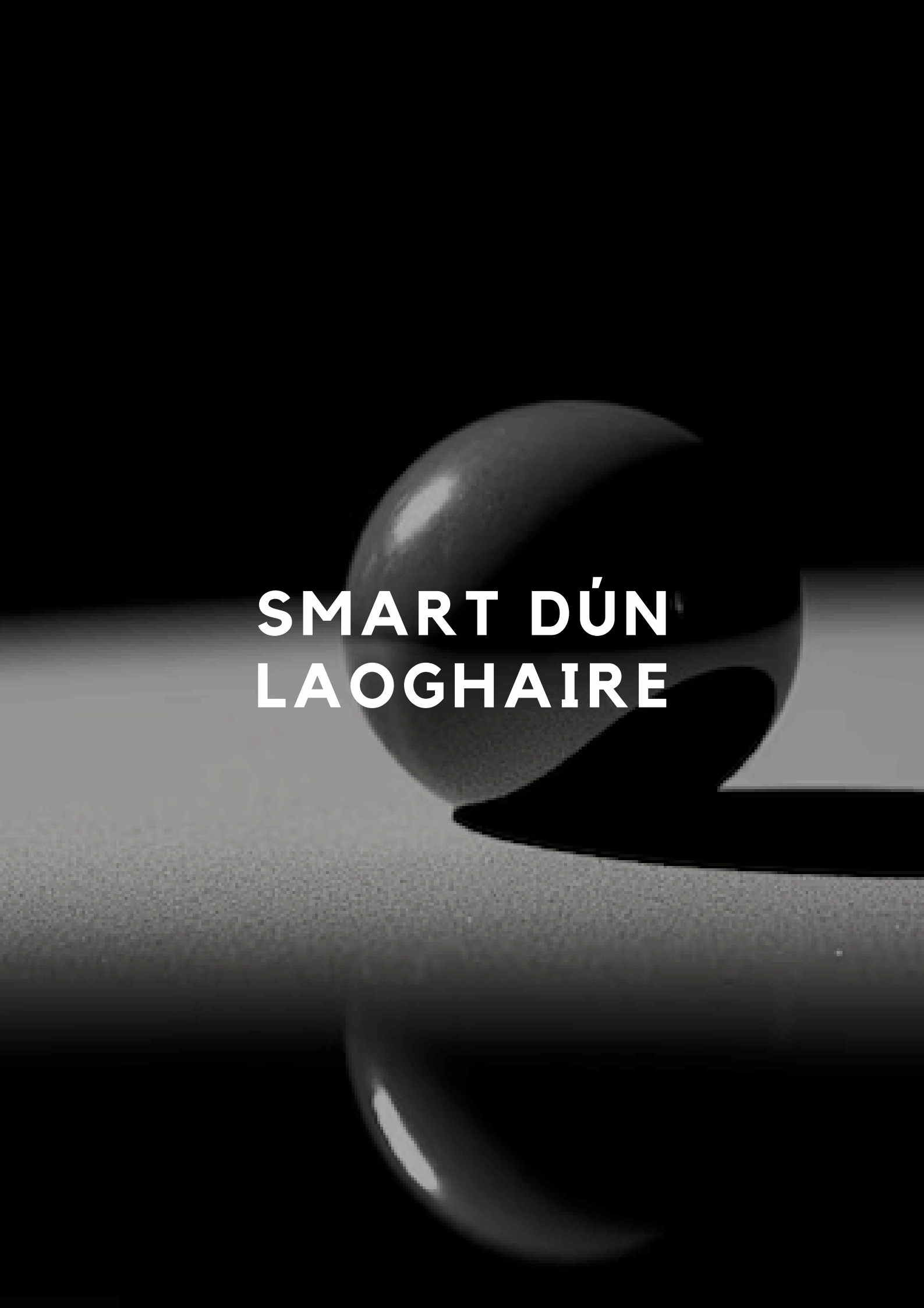
Imagine the impact. Shatter the mirror into a thousand pieces and let the light of different opinions come together and shine upon our present. This way, by becoming more aware of how intertwined the future, the present and our actions are, we will hopefully become less scared and more welcoming towards the future.

Imagine the impact. Include the future in your conversations and dare to question our present. Dare to ask 'what if' questions and to challenge the most popular ideas or technologies.

This second iteration of Trendhunters was the most challenging one yet, in all of the different meanings of the word. May this report be just as inspiring and help you to see our present and futures through a different lens. Be prepared to feel excited and terrified at the same time.

Watch the future unfold as you read.
Yours sincerely,

Amber Desprets


SMART DÚN
LAOGHAIRE

Smart Dún Laoghaire

Our mission and vision

Smart Dún Loaghaire is a smart district, part of the Smart Dublin ecosystem, that is contributing to the development of a smart city in Ireland's capital city. Based in Dún Laoghaire town, the Smart Dún Laoghaire district programme brings technology to life for the benefit of the community. It was established to strengthen the town's response to climate challenges and answer the question 'How can emerging technologies future-proof this popular coastal destination?'.

Due to its location and popularity, it faces two key challenges. The first is environmental resilience, as coastal towns become increasingly vulnerable to the impacts of climate change. The second is sustainable mobility, with growing numbers of visitors and residents travelling into and about the town. As the Dublin DART – the town's main artery – runs along the seafront, these two challenges are inextricably linked. Smart Dún Laoghaire is therefore a smart city testbed through which we use innovation and technology to address these challenges.

A testbed gives researchers an opportunity to trial new technology and solutions in a real world environment. Towards the push for sustainability and resilience in cities, Smart Dún Laoghaire facilitates research leading to large scale exemplars. These testbed projects involve researchers from world leading universities and cutting-edge technology.

The Smart Dún Laoghaire programme takes an applied research approach, involving data-driven decision making and on-the-ground technological innovation. Working alongside European counterparts, it maintains strong regional, national and international collaborative partnerships, so that local interventions reflect global best practice.

Our work

Since its launch in 2022, Smart Dún Laoghaire has developed research projects focused on climate action, inclusive of both mitigation and adaptation. Specifically these projects include urban resilience enhancement, sustainable travel and deployment of IoT solutions.

The people involved

The Smart Dún Laoghaire district programme is a partnership between Dun-Laoghaire Rathdown County Council and the SFI CONNECT Centre. Our academic partner CONNECT brings leading IoT research and provides expertise in emerging and cutting-edge technology. Dún Laoghaire Rathdown County Council is responsible for the planning and development in Dún Laoghaire and working with local communities to address challenges they face.


TRENDHUNTERS

Trendhunters

Smart Dún Laoghaire's engagement programme Trendhunters was established as a response to the ever-changing society and uses citizen science to work towards future-proofing the town. During this 12-week programme, Smart Dún Laoghaire engaged with the local community to teach them how to conduct futures research and use this new knowledge to create preferred images of the future. Smart Dún Laoghaire aimed to use these images of the future as input into the creation of better and more inclusive futures for our citizens.

The aim of this futurism engagement programme was to raise more awareness around futures studies to demonstrate its importance in engaging our citizens to drive change from the bottom-up in a smart city environment. It focused on the exploration and the shaping of preferred personal futures and on preparation and adaptation for probable futures.

This programme focused on trendwatching and futures studies and students involved in the programme learned how to identify and analyse societal trends, to spot emerging trends and signals of change, to create scenarios, to create alternative futures, to design artefacts of the future and to speculate around emerging tech, science and innovations. Each student had the opportunity to navigate the future of one chosen topic, ensuring their research displays their values, passion and a key focus point of their preferred future.

Trendhunters aimed to establish a springboard to an inclusive, future-proof town where all citizens feel fulfilled.

A first iteration took place from November 2022 until February 2023 and a second iteration took place from October 2023 until March 2024. This report discusses the results of the second and final iteration.

'This programme is at the interface of futurology and smart cities, making it a valuable source for future smart city projects that could future-proof the city.'
- Amber Desprets, initiator and leader of Trendhunters.

The second and final iteration

‘During this second iteration, 5 students were actively involved in the programme with each student submitting a unique piece of research, navigating the future of an exciting topic. This limited number of participants enabled microschooling in this iteration. The 12 workshops of this iteration held immensive power as they provided a safe space for each student, encouraged intimate dialogue and fostered a culture of collective growth.

No matter the differences in background, interests or future plans, a common ground was found in each workshop. That common ground could have been an agreement in opinion, finding the same scenario appealing or recognising that our pasts are more interwined than first anticipated.

In this second and final iteration, 4 futures were navigated: the future of health (2x), the future of automation, the future of space exploration and the future of global governance and international cooperation during a climate crisis. At first, these futures seem to be worlds apart, but when dialogue started and curiosity became stronger than judgement, we discovered that the future of automation and the future of space both share their past as evolutions in engineering have contributed to successes in both fields.

The future of health and the future of automation are both focused on AI, and if climate change stays stronger than our global efforts and we are forced to find solutions beyond our planet, than we will be in need of a global agreement on space exploration and governance.

All citizens, including these 5 brave students, shape the ground we stand on and as their mentor throughout this programme, I could not be more proud of their achievements and their determination. May this report give them the recognition they deserve. Here’s to the future and to our future leaders.’

- Amber Desprets

The second generation of Trendhunters

Dillon Slattery Lopez Mongameli Sidambe Harry McGuire

Xiaohan Lin

Raul Mazzucchi

The workshops

Workshop 1 – The theory of trendwatching

This workshop teaches the students more about the theory behind trendwatching. By focusing on the trend sustainability, the students learn more about this trend, what is driving sustainability and the variety of products and services that are part of this trend. They learn to identify trends by analysing sustainability articles.

Workshop 2 – Trendhunt

This workshop teaches the students how to identify various trends by clustering 145 articles and photos under the right label. During this workshop, the students get a broad overview on today's trends, which innovations are part of which trends.

Different innovations or products can all be part of the same trend. Next time you see a 'Boys cry too' T-shirt or 'Boys do cry' children's book, know that they're both part of the *'reframing masculinity'* trend.

Workshop 3 – Photohunt

Trends are visible everywhere, especially in the city. During this workshop, the students learn why trends often start on the streets and how to recognise trends around them and in Dublin city.

This workshop gives them the opportunity to cluster multiple photos, link them to the right trend and discuss which of them could of importance to our future.

What is depicted on some of the photos? A voluntary drugs deposit box, algorithmic perfumery, 'Nando's goes neutral' and a sweater made from cat hair! Can you guess which trends these photos are part of?

Workshop 4 – Image of today

Trends have drivers, impact and consequences. During this workshop, the students learn what drives the trends inclusion, artificial intelligence and sustainability and what the consequences of these trends currently are on our society.

They will also critically analyse emerging innovations (eg: multi-parent baby or plastic turned into vanilla ice cream) and which impact they can have on future society, as well as examine the current trendlandscape of Dublin.

'The use of fossil fuels and our dependence on it since the industrial revolution has led to over-production, over-consumption and a world based on linear systems. These elements have caused global warming which has a widespread effect on the physical planet. These effects cause people to question how we can live more sustainably, adopt circular systems and vote for better policies.'

Workshop 5 – Future of Music Experience

This workshop teaches the students how to navigate the future of a specific topic. They can choose from three topics: future of food, future of music experience or the future of fashion. Each group has to analyse the data they receive, make anticipations about where things might be heading, which innovations could exist in the near future and how the three cases, even though they are about different topics, are connected to each other.

This iteration, they chose the future of music experience!

"A shift is happening towards atmospheric experiences, feeding the potential of future AI music, AI-music drone shows, AI-generated personalised music, emotech for music, underwater concerts, eco-based concerts and concerts in space...

The future of music experience will be a mix of emotions, spirituality, AI and sustainability."

Workshop 6 – The Future of Water

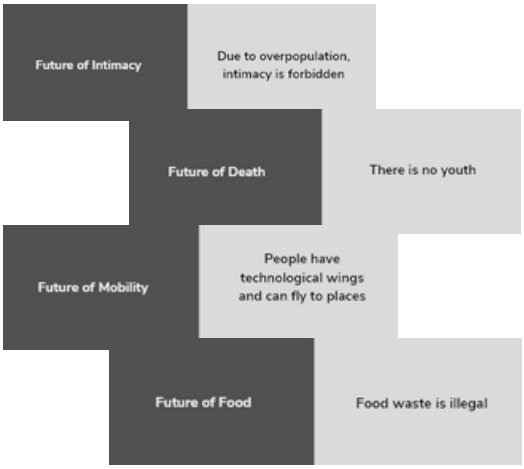
This workshop focuses more on foresight, using speculative design to navigate the far future of water. Speculation is key and the students will speculate how emerging tech, issues and events can affect our oceans and coastal city in the future and how design can help us solve potential future challenges.

The outcomes of this workshop are possible futures and an artefact of the future.

Workshop 7 - Values and assumptions

As we look towards the future, it is essential to examine our values and assumptions and how they shape the world around us. Our values, such as safety, security and sustainability, will continue to guide us as we navigate the challenges and opportunities that lie ahead.

This workshop is all about challenging our assumptions and biases, by opening up the conversation and discussing tiny, extreme futures.



Workshop 8 - Our shared history

This workshop focuses on the shared history amongst the different futures.

What important historical events have happened in each topic? What social, cultural and technological impact did those events have then? What are the effects of these events on our present?

Are there any commonalities, differences or insights to discover amongst these different histories?

1796

Smallpox vaccine, foundation of vaccination

1928

Discovery of penicillin

1977

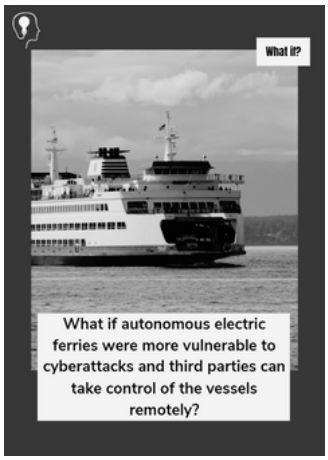
Mass vaccination campaigns

2015

The Sustainable Development Goals

Workshop 9 – Landscape analysis

To kick-off our research, this workshop helps the students identify early signs of change, anticipate potential risks and challenges, as well as understand what is holding us back and pushing us forward and what the potential impacts of changes could be.

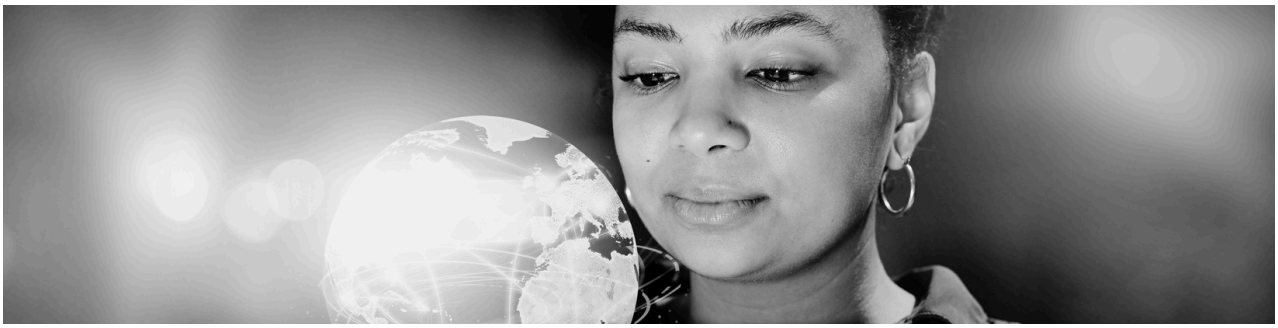


Workshop 10 – Scenario creation

When you think about the future, you think about potential future scenarios. Some utopian, some dystopian.

There are methods available that help with scenario creation and this workshop was all about exploring and testing those methods.

What if governance is accepting AI but the public isn't? What would the world look like if this would ever be the case?



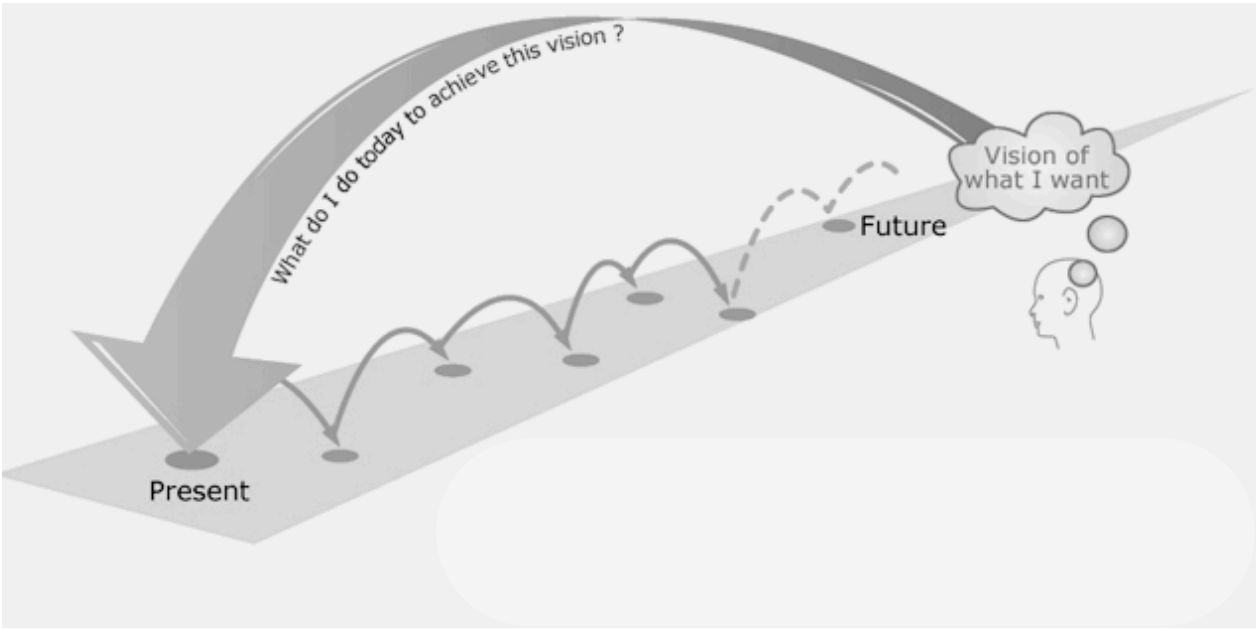
Workshop 11 – Alternative Futures

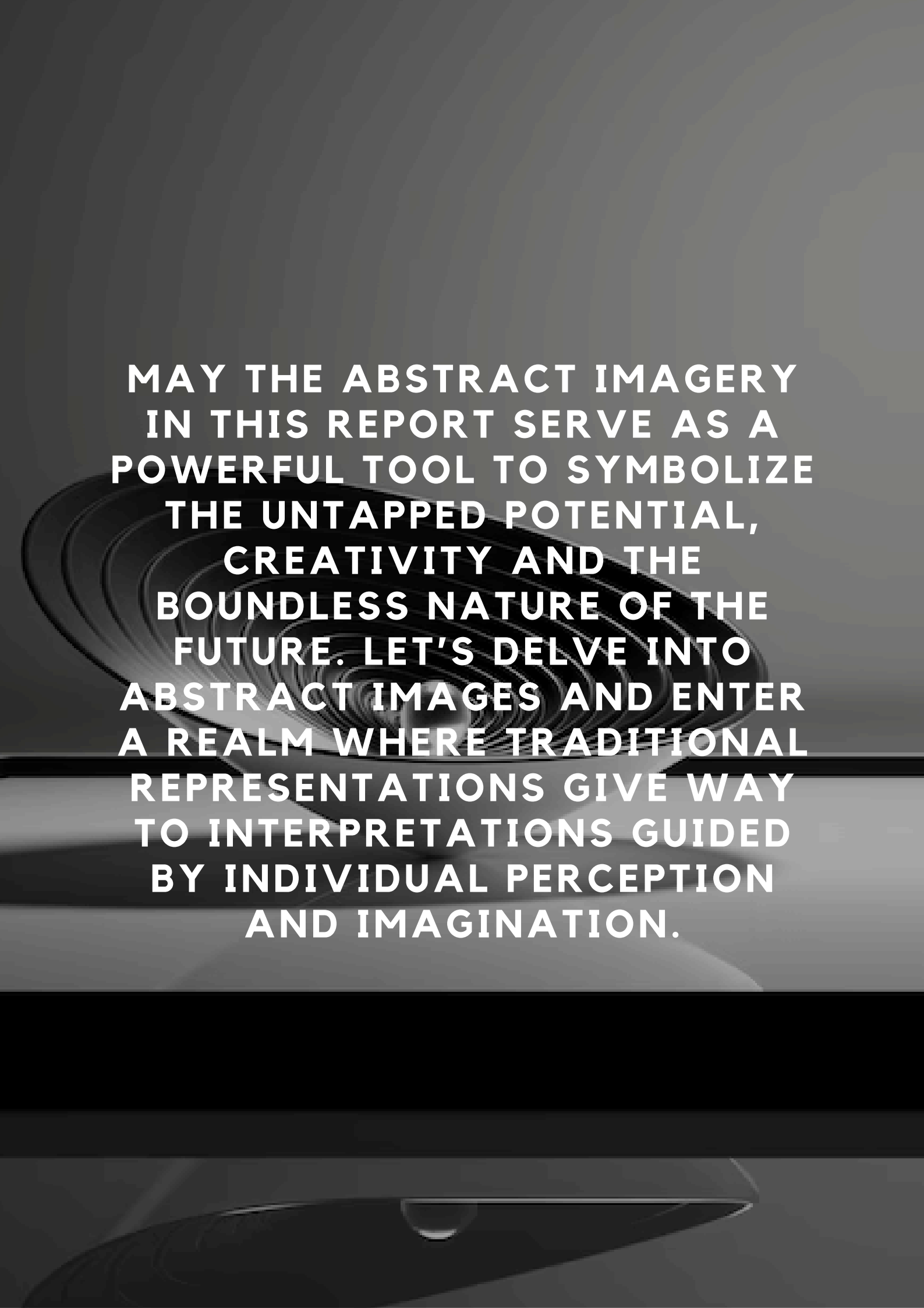
Most people assume there is a single future ‘out there’, which couldn’t be further away from the truth. Futures studies is about studying multiple images of the future. All the existing images of the future can be grouped into four categories.

In this workshop, the students learn to summarise their research and create 4 ‘final’ futures.

Workshop 12 – Advice for the council

To wrap up their research, the students proposed an advice for Dún Laoghaire Council which could either be a project proposal, a roadmap to achieve a certain future or an artefact of the future.




MAY THE ABSTRACT IMAGERY IN THIS REPORT SERVE AS A POWERFUL TOOL TO SYMBOLIZE THE UNTAPPED POTENTIAL, CREATIVITY AND THE BOUNDLESS NATURE OF THE FUTURE. LET'S DELVE INTO ABSTRACT IMAGES AND ENTER A REALM WHERE TRADITIONAL REPRESENTATIONS GIVE WAY TO INTERPRETATIONS GUIDED BY INDIVIDUAL PERCEPTION AND IMAGINATION.


SIGNS OF THE
FUTURE IN THE
PRESENT

Megatrends

The following 10 megatrends will continue to influence our society in the next 10 to 15 years:

01 **HOLLISTIC WELLBEING**	Health means so much more than just having a healthy body. People are starting to invest in their soul and mind and are fighting for a healthy balance in all the levels of their life.
02 **INDIVIDUALI-SATION**	Individualisation is about the increased wish to focus on ourself and to pay more attention to our qualities, to limit our intrusive thoughts and to gain more confidence.
03 **SOCIETY REIMAGINED**	Our society is changing. Old beliefs do not work anymore and change is being demanded from the bottom-up.
04 **ATTENTION ECONOMY**	Time has become a valuable thing as people seem to have less of it. More players are trying to get our attention which causes resentment and fatigue on our environment.
05 **DIGITAL ERA**	Digitalisation has a clear impact on our daily lives as we become more dependent on digital gadgets. The digital world will keep on increasing over the next decade.

06 RISING TECH	More advanced technologies are being deployed on the market and this cycle will continue as the uncanny valley gap will slowly start to close.
07 DISTRUST SOCIETY	The distrust amongst the citizens in our society is increasing rapidly. There is little to no trust in the government.
08 CONNECTED HUMANS	The Connected Humans megatrend is all about feeling connected with each other, both in the online and offline world.
09 MULTI-SENSATION	As our attention span is at its lowest point since history, brands and organisations are approaching us with creative ways and new products to keep us entertained.
10 NEO-ECOLOGY	Neo-ecology is about all things sustainable. Which trends are helping us fight climate change and improve our relationship with Mother Earth?

Eyecatching trends within Hollistic Wellbeing:

01 HOLLISTIC WELLBEING

gender fluidity

digital spa

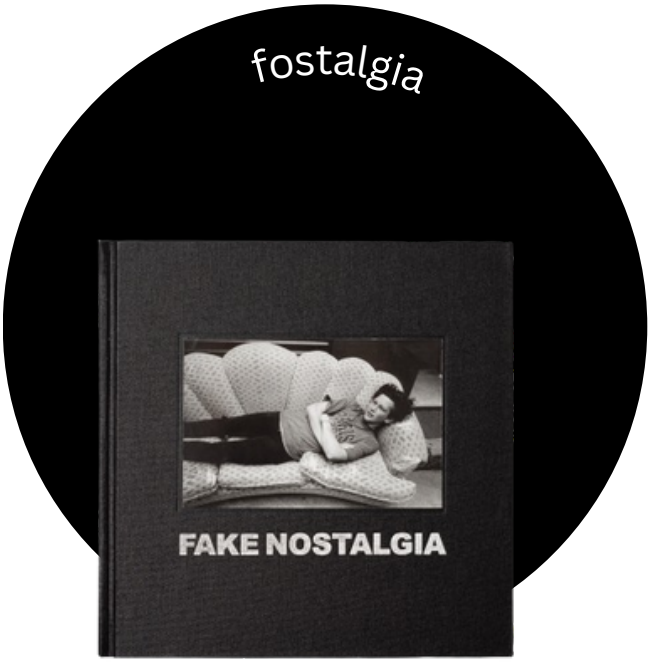
active silence

Eyecatching trends within Individualisation:

02 INDIVIDUA-LISATION

redefined ambition

fostalgia



joyconomy

Eyecatching trends within Society Reimagined:

03 SOCIETY REIMAGINED

reframing masculinity

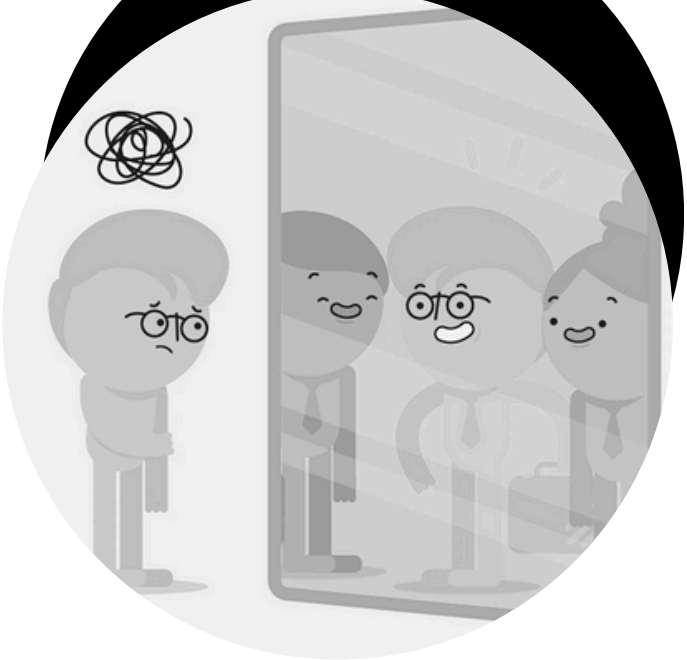
rewirement

celebrating female

Eyecatching trends within Attention Economy:

04 ATTENTION ECONOMY

FOMO



unexpected formats

streaming wars

Eyecatching trends within Digital Era:

05 DIGITAL ERA

slow retail

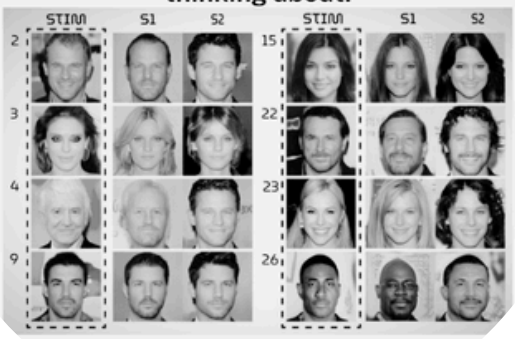
sensation marketing

creative commerce

Eyecatching trends within Rising Tech:

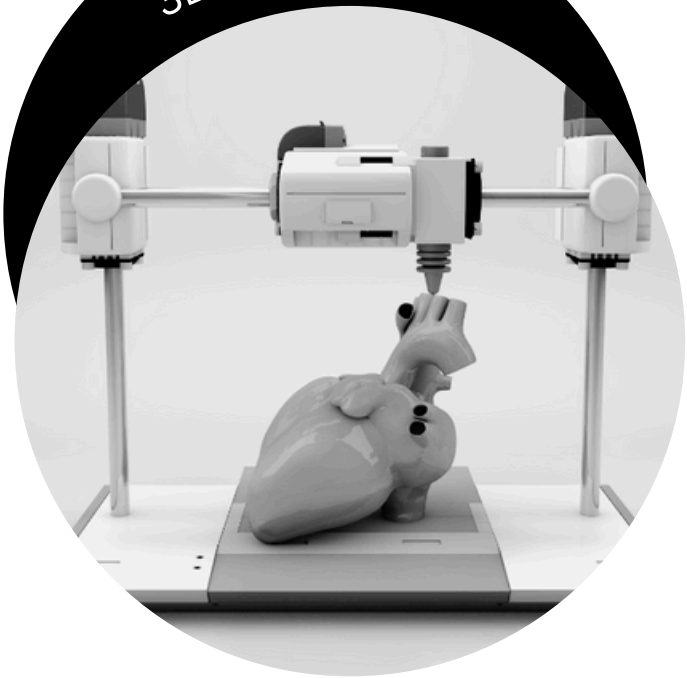
06 RISING TECH

intuitive tech



tech alienation

3D-printing



Eyecatching trends within Distrust Society:

07 DISTRUST SOCIETY

Eyecatching trends within Connected Humans:

08 CONNECTED HUMANS

authentic inlfuencing

climate optimism

creative activists

Eyecatching trends within Multisensation:

09 MULTI-SENSATION

Eyecatching trends within these Neo-Ecology:

10 NEO-ECOLOGY

An emerging trend within each megatrend:

01 HOLLISTIC WELLBEING

02 INDIVIDUA-LISATION

03 SOCIETY REIMAGINED

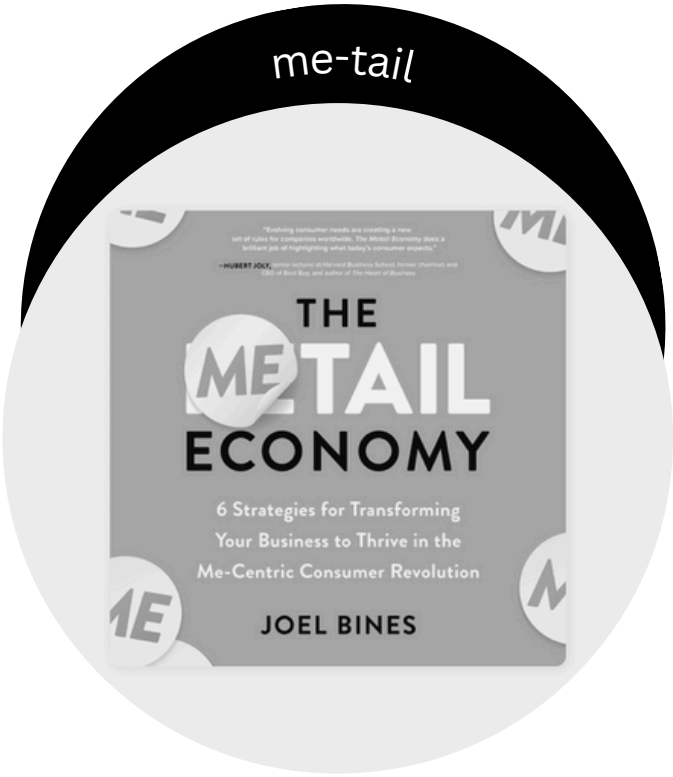
cell agriculture

04 ATTENTION ECONOMY

visual zeitgeist

05 DIGITAL ERA

me-tail



06 RISING TECH

fashion tech

07 DISTRUST SOCIETY

08 CONNECTED HUMANS

09 MULTI-SENSATION

10 NEO-ECOLOGY

Important to know:

1. The images of the future in this report aren’t guaranteed;
2. Acknowledge that it is a matter of being prepared for anything, not everything;
3. The most insane scenarios or questions are often the most useful ones;
4. Imagination is key. So is curiosity;
5. This report was written to encourage responsibility and hope, not fear.

FUTURE OF SPACE EXPLORATION AND AI

Researcher: Mongameli Sidambe

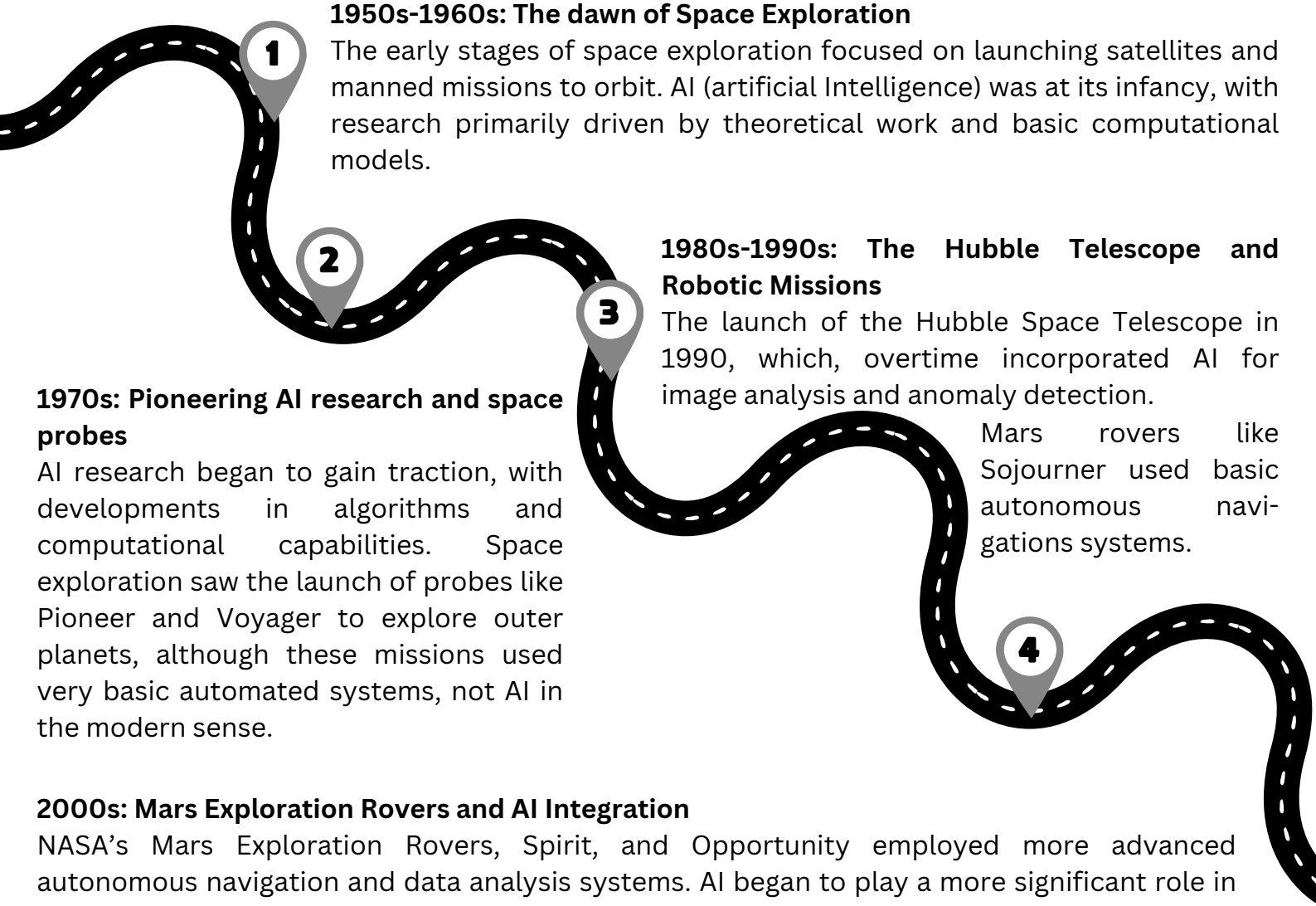
Future of Space

This research project delves into the current landscape and future possibilities at the intersection of space exploration and artificial intelligence (AI). By employing a combination of trend analysis techniques, conducting futures research and case studies, the project aims to identify the key factors driving the future of these domains and offer actionable insights to relevant stakeholders.

The project's findings highlight the present trends, future potentials, challenges, and strategic recommendations pertaining to the integration of AI in space exploration. Through the analysis of current trends and case studies, the research uncovers the key drivers shaping the future of these domains. Based on these findings, the project provides actionable insights and strategic recommendations for stakeholders to consider.

Roadmap of Space

History of Space Exploration and Artificial Intelligence



1950s-1960s: The dawn of Space Exploration
The early stages of space exploration focused on launching satellites and manned missions to orbit. AI (artificial Intelligence) was at its infancy, with research primarily driven by theoretical work and basic computational models.

1970s: Pioneering AI research and space probes
AI research began to gain traction, with developments in algorithms and computational capabilities. Space exploration saw the launch of probes like Pioneer and Voyager to explore outer planets, although these missions used very basic automated systems, not AI in the modern sense.

1980s-1990s: The Hubble Telescope and Robotic Missions
The launch of the Hubble Space Telescope in 1990, which, overtime incorporated AI for image analysis and anomaly detection.
Mars rovers like Sojourner used basic autonomous navigations systems.

2000s: Mars Exploration Rovers and AI Integration
NASA's Mars Exploration Rovers, Spirit, and Opportunity employed more advanced autonomous navigation and data analysis systems. AI began to play a more significant role in processing vast amounts of data sent back to Earth.

2010s: Curiosity Rover and Deep Learning
The Curiosity Rover, landing on Mars in 2012, showcased improved AI capabilities for navigation, environment analysis, and decision-making. The use of deep learning and AI algorithms became more important in analysing space images and data.

2020s: AI Autonomy and Beyond
Missions like NASA's Perseverance Rover and ESA's ExoMars program demonstrate high levels of autonomy and AI-driven science operations. AI technologies, including machine learning and neural networks, are essential for navigating, analysing samples, and selecting study targets on Mars and beyond.

AI in Satellite Technology
The development and deployment of satellite constellations for Earth observation, communication, and navigation increasingly rely on AI for data processing, object tracking, and operational management.

Prospects: AI and Deep Space Missions
AI is expected to play a crucial role in future deep space and crewed missions, including Artemis to the Moon, missions to Mars, and potentially beyond. AI technologies will drive advancements in life support systems, habitat management, and real-time decision-making in environments where human is limited by communication delays.

Exploring space and AI

The future of space exploration and artificial intelligence (AI) is a rapidly evolving field, with new developments and innovations emerging at a breathtaking pace. In this chapter, the potential impacts, challenges, and opportunities of these developments are examined, providing a comprehensive and insightful overview of the future of space exploration and AI.

Current threats

Space exploration and the use of artificial intelligence (AI) come with their own set of threats and challenges. One of the most pressing threats is the increasing amount of space debris, which can pose a significant risk to both satellites and human spaceflight as space traffic continues to grow. This debris, which includes defunct satellites, spent rocket stages, and fragments from collisions, can travel at high speeds and cause extensive damage if it collides with operational spacecraft. To mitigate this threat, AI can be used to track and predict the paths of space debris, enabling spacecraft to maneuver out of the way and avoid potential collisions.

Another significant threat in space exploration is the vulnerability of satellites and spacecraft to cyber-attacks. As AI is integrated into space systems, it is crucial to have robust cybersecurity measures in place to protect against these threats. The consequences of a successful cyber-attack on a spacecraft or satellite can be severe, ranging from data loss and system failures to the complete loss of the spacecraft. Therefore, it is essential to ensure that AI systems in space are designed with security in mind, using best practices and proven techniques to protect against cyber threats and ensure the safe and reliable operation of spacecraft and satellites.

Current challenges

The integration of AI in space exploration also presents several challenges, including ethical governance issues and interoperability concerns. With the use of AI in space, there are questions about the governance of autonomous systems, particularly in international waters where no single country's law applies. This raises concerns about accountability, transparency, and the ethical use of AI in space. Ensuring that AI systems are designed and operated in a responsible and ethical manner is crucial for maintaining trust and confidence in space exploration and avoiding potential conflicts.

Another significant challenge is interoperability, as many countries and private companies are operating in space, and ensuring that different AI systems can work together is a complex task. This requires standardization, collaboration, and the development of common frameworks and protocols for AI systems in space. Without effective interoperability, there is a risk of fragmentation, duplication, and inefficiency, which can hinder the progress of space exploration and limit the benefits that can be achieved. Addressing these challenges requires a concerted effort from all stakeholders, including governments, private companies, and international organizations, to ensure that AI is used in a responsible, ethical, and effective manner in space exploration.

Emerging issues

The use of AI in space exploration also brings emerging issues to the forefront, such as AI autonomy and the use of AI in satellite analysis. As AI systems become more autonomous, there is a risk of them making decisions without human oversight, which could lead to unforeseen consequences. This raises questions about the accountability and transparency of AI systems, and the need for effective mechanisms to monitor and control their behavior. Ensuring that AI systems are designed and operated in a responsible and ethical manner is crucial for maintaining trust and confidence in space exploration and avoiding potential conflicts.

A second emerging issue is the use of AI in satellite analysis, where AI is used to analyze data for earth observation. Issues such as spatial apartheid, highlighted in the MIT Review article, point to the need for careful handling of the insights AI provides from such data.

This requires a nuanced and contextual understanding of the data, and the ability to distinguish between patterns and correlations that are meaningful and those that are not. Addressing these emerging issues requires a concerted effort from all stakeholders, including governments, private companies, and international organizations, to ensure that AI is used in a responsible, ethical, and effective manner in space exploration.

Opportunities

Despite all the challenges and threats, the integration of AI in space exploration also presents several opportunities, including enhanced data analysis, improved spacecraft autonomy, sustainable space exploration, and new economic frontiers. AI can process and analyze the vast amounts of data from space missions much faster than humans, leading to new insights and discoveries. This can help scientists and researchers to better understand the universe and make new discoveries, which could have far-reaching implications for our understanding of the world and our place in it.

AI can also enable spacecraft to perform complex tasks autonomously, such as navigating and identifying landing sites, as demonstrated by lunar landers on the Moon's south pole. This can increase the efficiency and effectiveness of space missions, reducing the need for human intervention and enabling spacecraft to operate in more challenging environments.

In addition, AI can help to make space exploration more sustainable by optimizing the construction and deployment of environmentally friendly space technology, such as wooden satellites developed by Japan. This can help to reduce the environmental impact of space exploration, while also enabling more efficient and cost-effective missions.

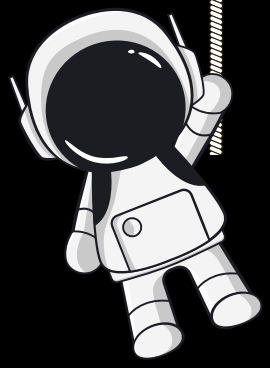
Finally, AI can help to open up new economic frontiers by enabling the utilization of space for economic activities, such as mining asteroids. This could be a new frontier for resources, providing opportunities for economic growth and development, and enabling new industries and businesses to emerge. Addressing these opportunities requires a concerted effort from all stakeholders, including governments, private companies, and international organizations, to ensure that AI is used in a responsible, ethical, and effective manner in space exploration.

Gravity and levitation

In the vast expanse of the cosmos, our astronaut, Mongameli, embarked on a mission of discovery.

His mission was driven by a dream of a future where AI manages and maintains habitats independently. This vision pulled Mongameli towards the stars, but the high cost of space travel and launch remained a significant challenge, weighing down the mission with financial constraints.

However, the rise of commercial space ventures like SpaceX and Blue Origin brought hope. Their success in developing reusable launch vehicles pushed the boundaries of space exploration, offering a path towards a more accessible and sustainable future.



Despite the financial burden, Mongameli continued the journey feeling determinated and inspired by the potential of technological advance-ments. Mongameli's journey highlighted the human spirit of exploration and its crucial role in space discovery.

What if AI is in charge in the future?

Evolution of Autonomous Spacecraft Systems

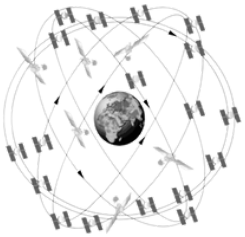
AI is increasingly being integrated into spacecraft systems to enhance autonomy. This evolution allows spacecraft to make real-time decisions, adapt to changing conditions, and navigate complex environments without constant human oversight. As AI algorithms improve and spacecraft become more sophisticated, the future holds the promise of entirely autonomous missions to explore distant planets and celestial bodies.

In the realm of autonomous spacecraft technology, the future also holds the promise of groundbreaking advancements set to transform space exploration. Among these innovations could potentially be self-repairing spacecrafts and advanced navigation AI.

Evolution of AI-Enhanced Satellite Data Analysis

As AI technology continues to advance, the future of satellite data analysis holds the promise of real-time, AI-managed satellite constellations. These constellations will be able to autonomously manage data collection, processing, and analysis, providing real-time insights and enabling rapid response to emerging situations.

Two possible future advancements could entail climate monitoring services and predictive GPS systems.



Evolution of Autonomous Spacecraft Systems

AI in space habitat management refers to the use of artificial intelligence to optimize and manage various aspects of space habitats, including resource management, environmental control, and autonomous systems. AI can help to maintain the life support systems necessary to establish human settlements in space. Currently, AI plays a supportive role in ISS operations, but its potential extends far beyond, with the capacity to manage lunar and Martian habitats in the future.

Two possible future advancements could entail AI environmental control systems, which could leverage AI technology to optimize and regulate the living conditions within space habitats, and robotic construction systems to revolutionize the way space habitats are built and maintained.

The ISS case study

International Space Station (ISS)
The International Space Station (ISS) serves as a remarkable case study for understanding the confluence of international cooperation, advanced technology, scientific research in space. Here are key points about the ISS that highlight its significance:

Launch and purpose
The International Space Station (ISS) is an orbiting laboratory assembled in stages starting with the launch of its first module in 1998. It is a collaborative effort between the space agencies of the United States (NASA), Russia (Roscosmos), Japan (JAXA), Europe (ESA), and Canada (CSA).

The ISS serves as a microgravity and space environment research facility, enabling scientific investigations across disciplines such as astrobiology, astronomy, meteorology, and fundamental physics

Structure and speed
The International Space Station (ISS) comprises pressurised modules for crew habitation and research, unpressurised truss segments for structural support, solar panels for power, and various robotics for maintenance and external cargo operations. It orbits Earth approximately every 90 minutes, travelling at a speed of 28,000 kilometres per hour (17,500 mph).

Achievements and research
The International Space Station (ISS) has contributed to breakthroughs in understanding the long-term effects of microgravity on the human body, advancements in space technology, and observations of Earth and outer space. The ISS also symbolizes unprecedented international cooperation, with agreements and contributions from 15 countries and has hosted astronauts from various countries.

AI Integration in ISS operations
Autonomous systems powered by artificial intelligence (AI) play a crucial role aboard the International Space Station (ISS). These AI-driven systems help manage a variety of routine tasks, including diagnostics and the control of robotic arms like Canadarm2 for cargo handling and station maintenance.

The Environmental Control and Life Support Systems (ECLSS) on the ISS utilize AI algorithms to optimize the operation of critical life support systems. These AI-powered systems ensure the air quality, water supply, and temperature aboard the station are maintained within safe limits for the crew.

AI in Scientific Research
AI assistants aboard the International Space Station play a crucial role in analyzing the vast amounts of data generated by experiments conducted on the ISS, spanning fields from materials science to biological studies. These AI systems help expedite the research process and enhance the accuracy of research findings.

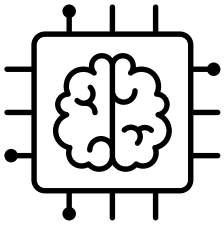
The ISS utilizes AI-driven health monitoring systems that analyze astronauts' health data in real-time. These systems identify potential health issues before they become serious, ensuring the crew's well-being during long-duration missions.

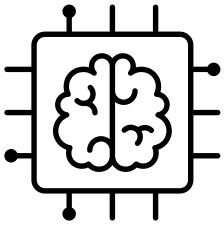
Future AI projects
The International Space Station (ISS) hosts Astrobee, a project involving free-flying robot assistants powered by AI. These robots are designed to help astronauts with chores and scientific experiments, demonstrating AI's role in reducing the crew's workload.

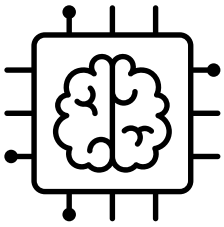
AI's integration into the ISS operations and research represents a pivotal shift towards more autonomous and efficient space exploration. It not only enhances the current capabilities of the ISS but also sets the stage for the future of manned space missions, where AI will be an indispensable partner in exploring the frontiers of space. The ISS serves as a proving ground for AI technologies that will drive the next generation of space exploration, highlighting the synergistic potential of AI and human intelligence in overcoming challenges of the final frontier.

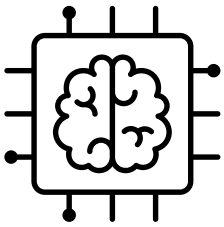
4 scenarios

4 different scenarios based on global cooperation and AI advancements in space exploration.

+ 	In a world where AI isn't very advanced but countries work together well, they use current tech to set up basic research bases on the Moon and Mars. Instead of rushing to claim land or make money, they take it slow, focusing on exploring space for science and keeping peace between nations. It's all about learning more about the universe and getting along with each other.	 -

+ 	In a world where AI is highly advanced and global cooperation is strong, we are experiencing a remarkable era of space exploration. Thanks to advanced AI technology, we are making significant progress in propulsion, life support systems, and building habitats in space. This progress has led to the creation of successful, sustainable colonies and the widespread integration of AI into everyday space activities.	+ 

 -	In a scenario of limited AI progress and global collaboration, space exploration is hindered by geopolitical tensions and a lack of significant technological advancements. The pace of advancement is slow and fragmented, characterized by separate initiatives and a heightened potential for disputes over space resources.	 -

 -	In a situation where AI is highly advanced but global cooperation is lacking, technologically advanced countries and companies take the lead in space exploration using AI. This leads to unequal progress and the possibility of certain entities monopolizing space resources. Space turns into a battleground for strategic rivalry, where having advanced AI capabilities becomes a crucial factor.	+ 

4 Futures of Space

Economic boost

The space sector is undergoing a significant economic transformation driven by the rapid growth of commercial space activities. The emergence of new revenue streams, including space tourism, asteroid mining, and space-based solar power generation, has injected substantial capital into the industry.

Isolated space efforts

Heightened geopolitical tensions have hindered international cooperation in the space domain, leading to more isolated efforts and raising concerns about the potential abandonment of joint space projects like the International Space Station (ISS).

Focus on sustainability

As the space sector continues to evolve and expand, there is a growing emphasis on ensuring the long-term sustainability of space activities. This includes a focus on responsible usage of space resources, effective debris management, and minimizing the environmental impact of space launches.

New economic systems

The rapid advancements in space technology and exploration have given rise to new industries and economic systems that leverage space resources and the unique conditions found in the space environment. These developments are profoundly transforming various aspects of society in remarkable ways.

A probable future examined

Artificial Intelligence (AI) makes sure that life support and resources are managed well in space habitats. These habitats recycle air, water, and waste, just like Earth's natural cycles, to keep a livable environment. They also have healthcare centers and recreational spaces to take care of the physical and mental health of the people living there.

What expectations are rooted in our society that make this future probable?

There is a widespread expectation that technological advancements will continue to drive the development of self-sustaining habitats capable of supporting life in space. This belief reflects a general societal confidence in human ingenuity and the ability to overcome the challenges of creating livable environments in the hostile conditions of space.

Alongside this expectation, there is an assumption that space may offer a potential solution to the ultimate failure of Earth to support an ever-growing human population.

Another presumption that advanced technologies, such as artificial intelligence (AI) and other sophisticated systems, will become reliable enough to manage the complex life support requirements of these space habitats without the need for constant oversight and intervention from Earth-based entities.

'I'm concerned about becoming too reliant on technology, potentially leading to catastrophic failure should systems fail.'
- Mongameli Sidambe

Preferred future

Mongameli's preferred future is called 'The Symbiotic Space Ecosystem Exploration which combines Advanced AI and space exploration.' In this future, AI helps people do their jobs better and space gives AI many chances to be used. There are orbital platforms and outposts on other planets that serve as hubs for scientific advancement, resource harvesting and traveling far into space.

How should it become?

- Advanced AI Development: Focused research on AI with specific space application capabilities, including decision making in dynamic environments, deep space communication, and autonomous problem solving.
- Infrastructure Expansion: Building a network of space stations and colonies on the Moon and Mars, equipped with AI for autonomous operations and maintenance.
- Educational Programs: Establish specialized education and training programs to prepare a new workforce skilled in AI and space technology.

What is already here?

- AI in Space Probes and Rovers: AI technologies are currently used for navigation and data collection in missions like Mars rovers and Voyager probes.
- International Space Station: The ISS serves as a model for international collaboration and the utilisation of AI for environmental control and robotics.

“How will I notice change?”

“I will notice things have become better when I see increased accessibility to space, with regular and affordable space travel indicating a successful reduction in launch costs and improved technology. Sustainable living off-Earth will catch my attention, with thriving colonies boasting self-sustaining ecosystems showing that we have conquered the challenges of space habitation. Technological spillover from space benefiting Earth, like advanced materials, clean energy solutions, and telemedicine becoming commonplace, will be a clear sign of progress.

Enhanced global connectivity through space-based internet infrastructure providing high-speed connectivity across the globe will also indicate a more interconnected and technologically advanced society. These advancements will collectively signal a positive trajectory towards a more advanced and sustainable future, and I will recognize this progress as a significant step forward for humanity.”

- Mongameli Sidambe

Advice for councils

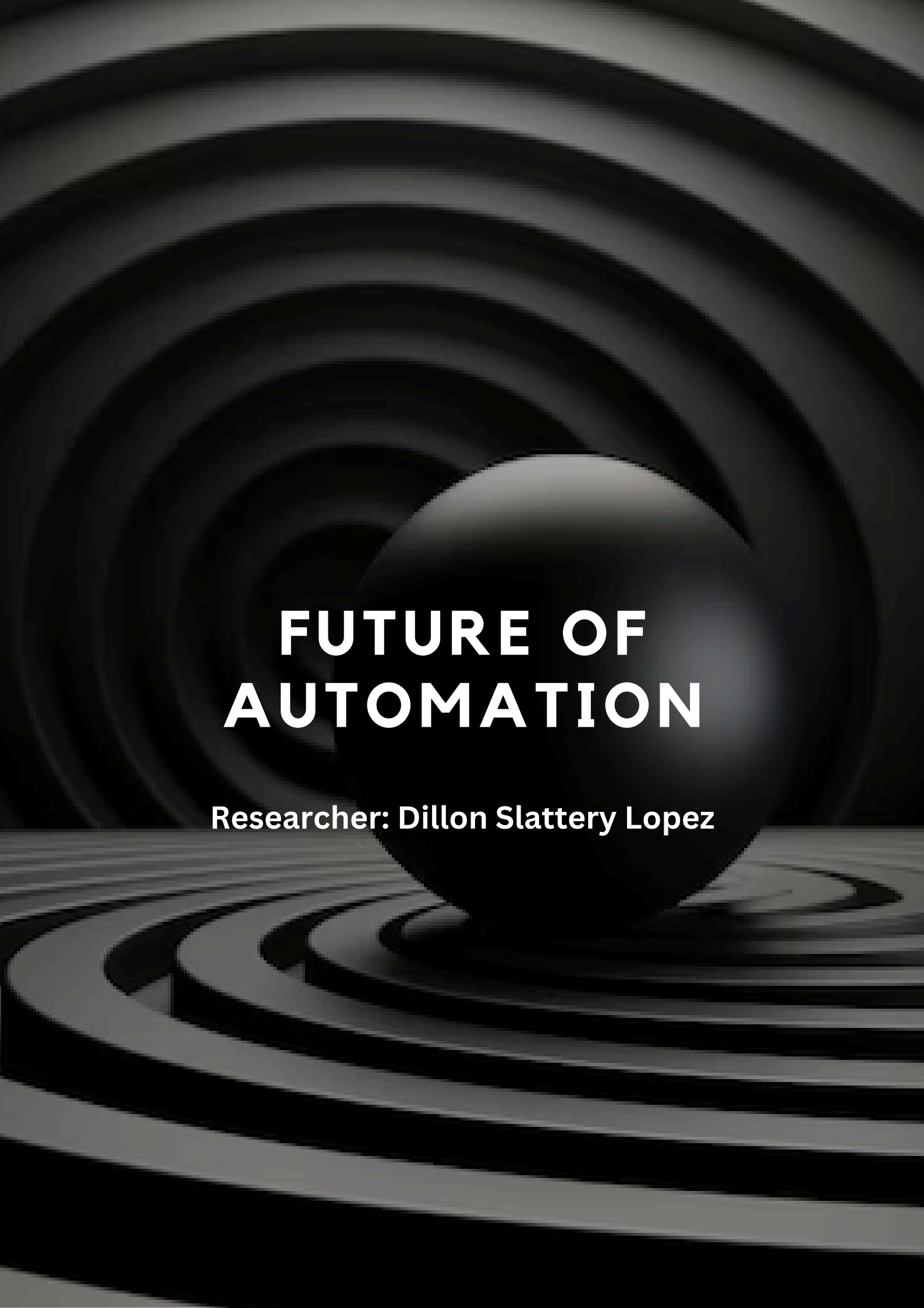
According to Mongameli, councils must keep in mind several important aspects about the future to ensure that they are well-prepared for the challenges and opportunities that lie ahead in space exploration. First, they must understand how artificial intelligence (AI) can enhance space missions, from data analysis to autonomous operations. By harnessing the power of AI, they can improve the efficiency and effectiveness of their space missions, making them more cost-effective and productive.However, they must also consider the ethical implications of using AI in space, particularly when it comes to decision-making and data privacy. They must ensure that they are using AI responsibly and ethically, taking into account the potential impact on individuals and society as a whole. Furthermore, they must prioritize sustainability in all of their space activities, minimizing space debris and environmental impact.In terms of focus points, they must prioritize investment in research and development (R&D) in AI and space technologies to maintain a competitive edge in the global space industry.

They must also develop educational programs to prepare a workforce skilled in space technologies and AI, ensuring that they have the talent and expertise needed to drive progress in this field. They must promote international cooperation for shared progress and regulation in space exploration, working together to ensure that they are all moving in the same direction.

To achieve these goals, they must take several steps. First, they must form strategic partnerships with industry leaders, academic institutions, and international space agencies to leverage their expertise and resources. Secondly they must also establish clear policies that govern the use of AI in space, including safety standards and guidelines, to ensure that they are using this technology responsibly and ethically.

Thirdly, they must support startups and innovation hubs that focus on space and AI technologies, providing them with the resources and support they need to thrive. Finally, they must encourage public interest and support for space programs through outreach and education, ensuring that they have the backing of their citizens as they embark on this exciting journey into the future.

To summarise, as a council, they must keep in mind the importance of integrating AI into space missions, considering the ethical implications of using this technology, and prioritizing sustainability in all of their space activities. By focusing on R&D, education, and international cooperation, and taking steps to form strategic partnerships, establish clear policies, support innovation, and engage with the public, they can ensure that they are well-prepared for the future of space exploration.



FUTURE OF AUTOMATION

Researcher: Dillon Slattery Lopez

Dublin Bus

This initiative spearheaded by EV - based ideas, not only has a large positive impact on the Air Quality of Dublin. But also the Climate Action plan as they reduce carbon emissions.

A total of 120 fully electric buses will not be able to cover over 136 different routes (according to Google), with 1,010 buses, of which the majority are not fully electric. That's an average of 7.4 buses per route. If we were to operate 120 fully electric buses, the average dramatically lowers to 0.9 per route.

© Dublin Bus

Electric Ferries

The Maritime Industry has not developed any fully electric Vessels. However, many projects are currently being researched.

Dún Laoghaire Harbour

Dún Laoghaire Harbour is home to many forms of Aquatic Vessels. One form of ship which is starting to be a consistent form of transportation is Cruise ships / ferries.

The Ferry is an exceptional contender when in operation, for the least amount of CO^2. Fully Electric Ferries will not have a major impact as all Dublin Buses converting to Battery Motors. However, an introduction of Cruises to DL Harbour will cause a dangerous change in CO^2 emissions and a change to Fully Electric Cruises will be necessary to meet EU emission targets.

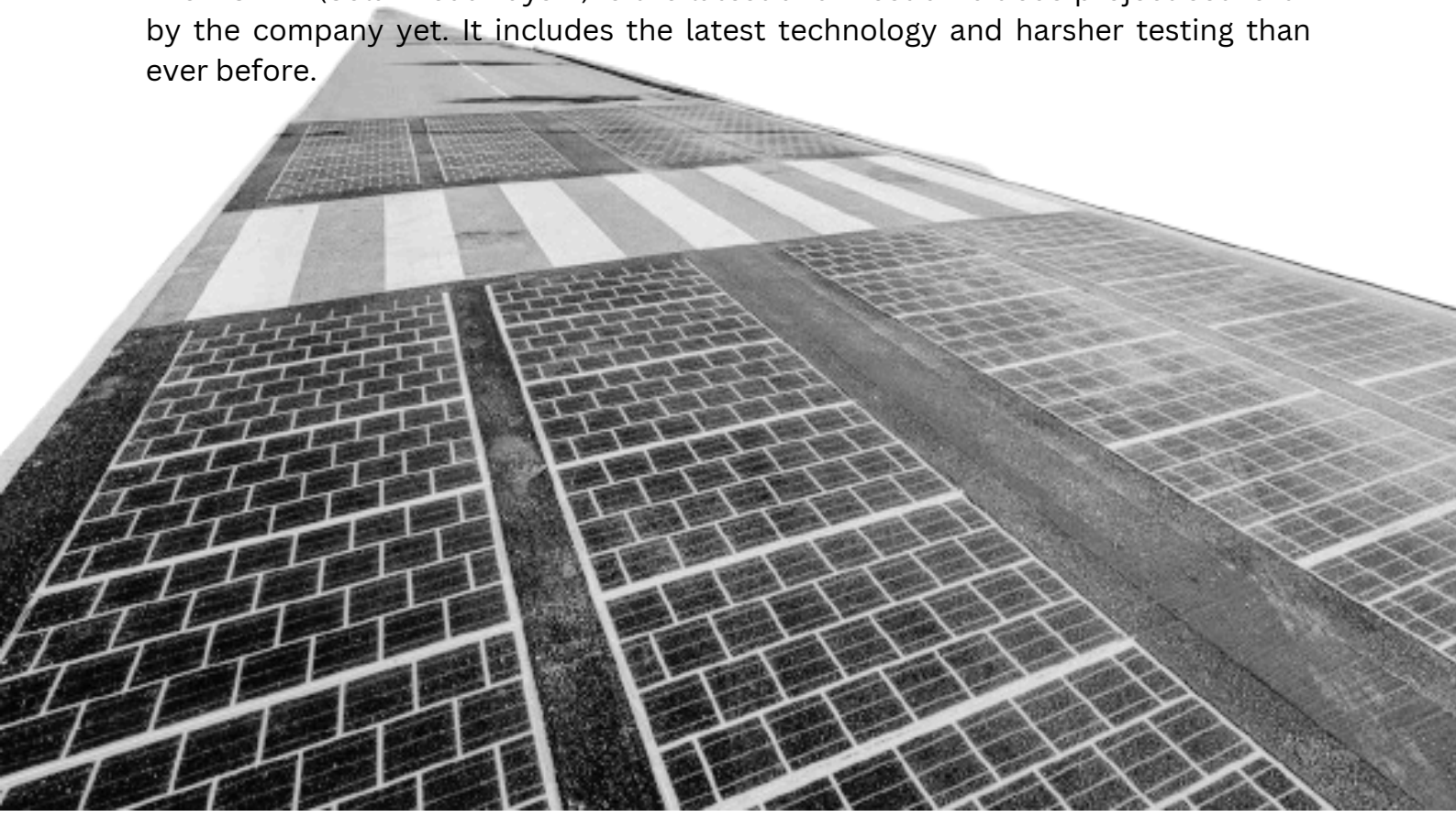
Dún Laoghaire's 2023 cruise season surpasses 2022 with 65 cruise ships having arrived with 79,000 passengers and 44,000 crews.

Solar Roadways

Solar Roadways is a company that specialises in an intelligent, next generation Roadway. They offer a new insight into a road, allowing the road to be easier to maintenance, transport cables as well as vehicles and also generates energy to charge all Electric Vehicles that drive on it.

Solar Roadways are currently testing on their roads to further improve the quality of their product, as shown. They are also receiving assistance from the US Government to further their roads in a generational effect. This also boosts the EV Market as Electric Vehicles will be able to charge its batteries while driving along it.

The “ SR4 “ (Solar Roadways 4) is the latest and most ambitious project set forth by the company yet. It includes the latest technology and harsher testing than ever before.



Drone use in Coastal Areas

Manna Drone delivery service is quite a simple alternative to Car or Van delivery. Drones are quieter, greener, quicker and also potentially more cost effective to the customer. But how can we use the Drone Delivery Service (DDS) in Dún Laoghaire?

Drones in Healthcare is starting to become a trend, as they are used for delivering organs, blood and small hand equipment. Drones are also used to deliver vital food and water packages to the residents of a rural setting, like Aran Islands. With Manna drones already operating in Balbriggan they could extend their services south to then deliver medical supplies and provide a faster, more sustainable catering delivery service.

Drones could also be used on ships to use a LiDAR scanner to scan the underwater depths, which can also be used in agriculture. Drones could also transport lifesaving equipment to ships along the coasts or to those who are in a dire need.

AI in Dublin

The AI we see and use in everyday life would be considered “Weak AI”. Leap Card machines, Siri and other applications are built through Weak AI. But what if we implemented “Strong AI” machines that will replace Information stations?

Should Strong AI replace underachieving appliances in society?

If AI information posts replaced the conventional two-way speaking service it would have a large attendance to its users as it would be a first of a kind. Many curious pedestrians would not at first, notice it as it would look and operate almost exactly like a conventional Information post.

AI could also replace timers on the street lights. It would allow the street lights to light when the AI understands that the area around it is becoming dark. As of now, Street lights could turn on while the area is still bright and waste energy.

© Dillon Slattery Lopez

Insights into tomorrow's world

Threats we should keep in mind

The future of automation and artificial intelligence (AI) has both positive and negative effects, especially for climate change, and there are several threats we should keep in mind.

AI technology uses a lot of energy and water, which can increase carbon emissions and worsen the climate crisis. AI tools can also create climate disinformation, such as fake videos, which can make it harder to take action on climate change.

Activists are worried about the risks of artificial intelligence (AI) and are pushing for stricter rules. They fear that AI could result in significant job losses, increase economic inequality, and endanger humanity's future.

Over-automation is another concern because it can increase energy use, carbon emissions, and electronic waste, which harms the environment. It's important to balance the benefits of automation with its environmental costs.

Clear communication and information are necessary to address these challenges. People need to know about the environmental impact of AI technology and how to use it sustainably.

A lack of budget is a significant barrier to addressing these issues. Enough money is needed for research, innovation, and developing environmentally friendly AI technologies that support climate action goals. Governments, businesses, and organizations must invest adequately to ensure AI progress positively contributes to environmental sustainability and climate resilience.

Opportunities we should focus on

The potential dangers outlined previously do not necessarily have to be viewed as negative. Instead, they can be seen as opportunities for growth and improvement.

AI technology can play a crucial role in combating climate change by enhancing data-driven decision-making, improving forecasting accuracy, and optimizing processes to reduce carbon emissions. By leveraging AI and machine learning, organizations can better understand climate patterns, forecast carbon prices, promote sustainable behaviors, and calculate carbon footprints to support informed decision-making and policy changes.

Activists can also play a significant role in shaping the future of automation and AI in the context of climate change. They advocate for responsible AI development, transparency, and accountability to ensure that AI technologies are used ethically and sustainably to address environmental challenges. Activists push for regulations that promote AI's positive impact on sustainability and climate action while mitigating potential risks and negative consequences.

Media and social media platforms provide avenues for raising awareness about the benefits of AI in combating climate change and promoting sustainable practices. Through effective communication and engagement, these channels can amplify the message of environmental conservation, encourage sustainable behaviors, and foster public support for AI initiatives aimed at addressing climate challenges.

Sustainability is a key focus for the future of automation and AI, with opportunities to develop eco-friendly technologies, reduce energy consumption, and promote environmental stewardship. AI can be harnessed to optimize energy usage, enhance resource efficiency, and support the transition to a low-carbon economy by facilitating carbon emissions mitigation and removal systems.

Donations and events present opportunities for funding and collaboration in advancing AI technologies for climate action. By supporting research, innovation, and projects that leverage AI for environmental sustainability, individuals, organizations, and governments can drive progress in combating climate change and promoting a greener future.

In the context of war, the future of automation and AI raises concerns about the ethical implications of autonomous weapons and the potential for AI to be used in military applications. It is essential to address these challenges by promoting responsible AI development, ensuring transparency, and establishing ethical guidelines to prevent the misuse of AI technologies in armed conflicts and warfare scenarios.

Mass adoption of autonomous vehicles

The event of "Mass adoption of autonomous vehicles in urban transportation networks" and its possible consequences were examined to understand the potential impacts of this technology on society, the economy, and the environment. The mass adoption of autonomous vehicles could lead to significant changes in urban transportation networks, including the disruption of traditional transportation industries and the establishment of new regulations and standards.

One of the first consequences of this event is the increased potential for misuse, as autonomous vehicles could be used for criminal activities. Additionally, the mass adoption of autonomous vehicles could lead to AI freedom in the US, more research on AI types, and the integration of AI into the police force.The adoption of autonomous vehicles could also result in the mass procurement of electric vehicles (EVs) and drones, leading to the implementation of sustainable fuel alternatives and the transition into AI industries.

Furthermore, the event could lead to the release of the SR5 (solar-roadways), the implementation of solar-powered vehicles and solar roadways, and the use of liquidized gases for recreational purposes.

However, the mass adoption of autonomous vehicles could also have negative consequences, such as the phase-out of long-range trucks, overpriced EVs, climate change issues, criminal use of EV parts and robberies.

Therefore, it is essential to examine the potential consequences of this event to understand the risks and benefits associated with the mass adoption of autonomous vehicles in urban transportation networks.

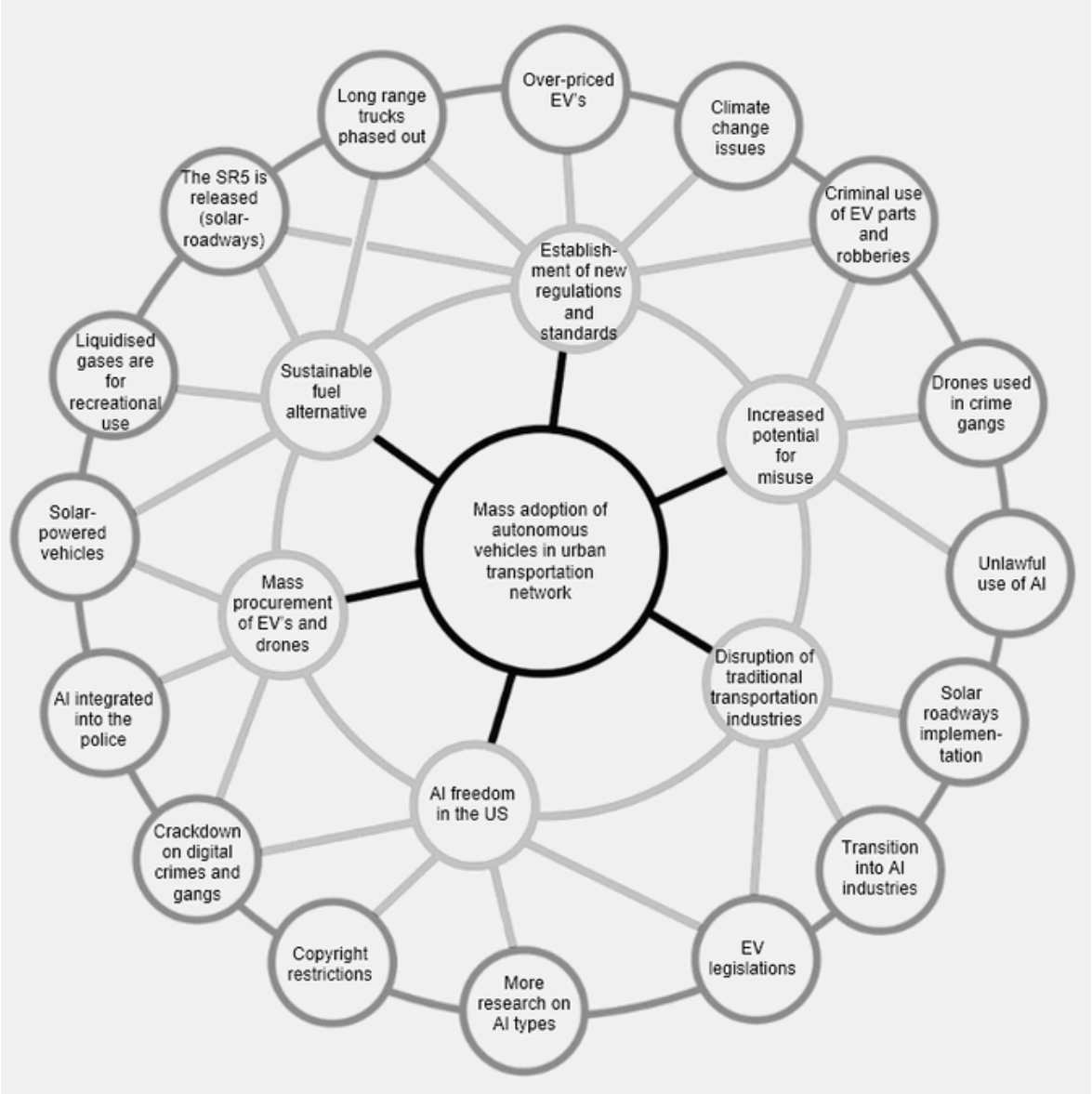


Figure n° 1 - Overview of the direct and indirect consequences of a mass adoption of autonomous vehicles in an urban transportation network.

What if automation is abandoned because governments act against further development?

What if the airline industry stopped?

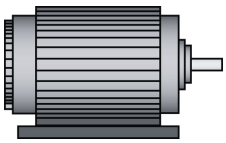
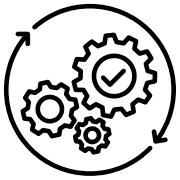
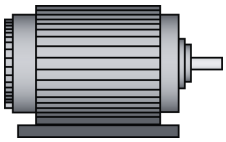
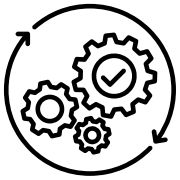
What if we need to limit the vehicles being used?

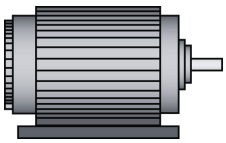
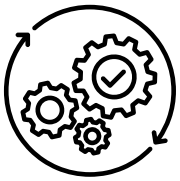
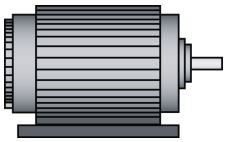
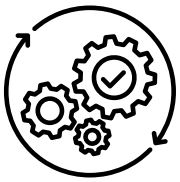
What if we need a new bio-fuel?

What if our sustainability targets aren't hit and automation is vital?

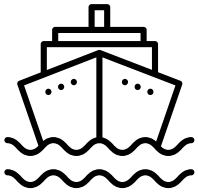
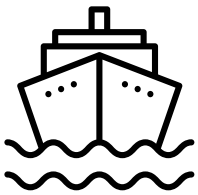
Exploring diverse scenarios

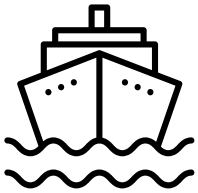
The different potential outcomes of advancements in automation and the motor industry.

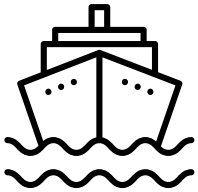
 -	The widespread adoption of automated lines in factories has led to increased efficiency, reduced production costs, and improved accessibility to automation technology. The automation of manufacturing processes has revolutionized the industry and as a result of automation, the mass production of DC motors has become more prevalent, leading to a significant decline in their price.	+ 
+ 	Automation has reached a new level of sophistication, merging completely with Strong AI. This integration of Strong AI with automation has led to the development of more advanced electric motors, with new visions and designs.	+ 

 -	The rapid advancement of automation technology has been halted as governments act against further development. As part of the drastic measures taken by governments to reduce emissions, motors have been banned due to their significant contribution to greenhouse gas emissions and climate change.	 -
+ 	Automation research is delayed due to its budget being focused in a new direction. there is a revolutionary spike in interest in motors, driven by advancements in electric motor technology, renewable energy sources, and sustainability initiatives. As part of the shift towards sustainable practices and reducing carbon emissions, the use of Internal Combustion Engines (ICE) is restricted to Motorsport use only.	 -

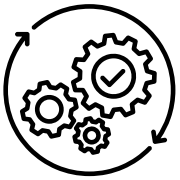
The different potential outcomes of advancements in automation and the maritime industry.

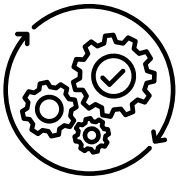
 -	The Maritime industry undergoes a transformative shift as automation enables the adoption of fully electric freight ships. Despite the potential benefits of transitioning to fully electric freight ships, the Maritime industry experiences disruption as it adapts to this new generation of technology.	+ 
+ 	The integration of AI and drones with fully automated ships revolutionizes the maritime industry's ability to navigate through shallow depths, opening up new routes and opportunities for trade and transportation. the adoption of solar power-based ships for long-distance journeys significantly reduces the time and cost associated with traditional maritime transportation. Solar-powered ships can harness the sun's energy to power their propulsion systems, enabling them to travel long distances without the need for frequent refueling stops.	+ 

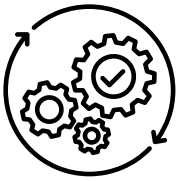
 -	Researchers in Automation are unable to reach a solution, leading to a period of stagnation and inefficiency in the maritime industry. Over time, the maritime industry becomes increasingly unviable, and as a result, it is completely dissolved and replaced by air transportation. Planes become the dominant mode of long-distance transportation.	 -

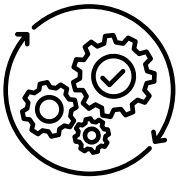
 -	The widespread adoption of automated ships increases the number of malfunctions that happen mid journey, causing life threatening emergencies. Using satellite technology and drones, a 3D resemblance of the ocean floor is created, allowing the team to identify potential hazards and navigate the ship to safety.	+ 

The different potential outcomes of advancements in automation and the road industry.

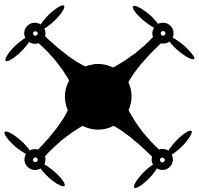
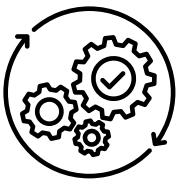
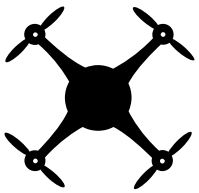
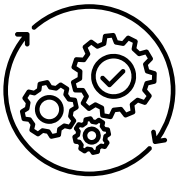
+ 	Solar roadways have replaced traditional asphalt and concrete roads, but the lack of proper governance and regulations has caused the solar roadways to be less reliable.	 -

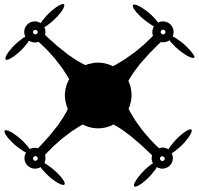
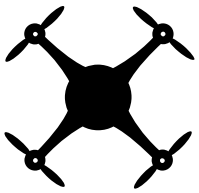
+ 	Solar roadways have replaced traditional asphalt and concrete roads, and it has been widely embraced by the government due to its benefits. Solar roadways are not only a road surface but also a power source for all battery-based homes and vehicles. The solar panels embedded in the road surface generate electricity that is stored in batteries and then distributed to homes and vehicles.	+ 

 -	Solar roadways is only available for private use, and the lack of governance has led to it being unregulated. Without proper regulation, there is no oversight of the installation and maintenance of solar roadways.	 -

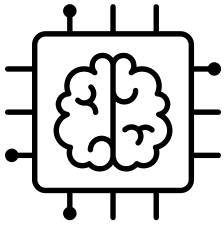
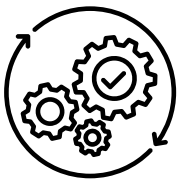
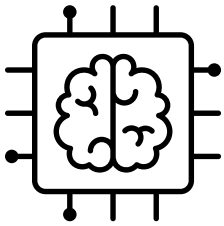
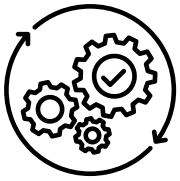
 -	In this scenario, solar roadways is a public infrastructure project, but its implementation comes with a significant cost, making it inaccessible to many due to its high price tag. Despite the expensive nature of solar roadways, it is fairly governed through market mechanisms and can potentially be subsidized to make it more affordable and accessible to a wider range of users.	+ 

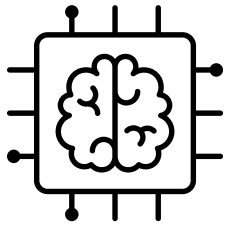
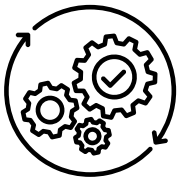
The different potential outcomes of advancements in automation and the drone industry.

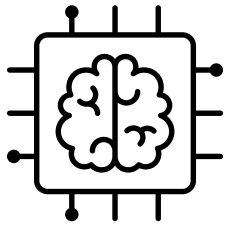
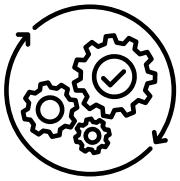
 -	Automation is common throughout society, with drones being heavily restricted around public areas. These strict regulations have been put in place to control their use around public spaces.	+ 
+ 	Automation has been seamlessly integrated into every aspect of society and daily life, revolutionizing how tasks are performed and services are delivered. With automation playing a central role in society, drones have also become a common sight in public areas such as parks, airports, and urban spaces.	+ 

 -	The widespread use of automation and machine learning in society has been curtailed due to concerns. As a result, most services have banned the use of automation, and machine learning has fallen out of favor. Society has embraced the responsible use of drones for various applications. However, the focus has shifted towards the sustainable use and disposal of drones. Rather than allowing drones to become obsolete and end up in landfills, there is a strong emphasis on disassembling and recycling them.	 -
+ 	Automation is primarily used in factories for manufacturing and production processes, but its high cost and complexity make it inaccessible to most other sectors. Drones have become an essential tool in logistics, particularly in the transportation of medical supplies.	 -

The different potential outcomes of advancements in automation and artificial intelligence.

 -	Automation causes a boost in vehicular motion, causing the transportation industry to experience significant changes due to the widespread adoption of autonomous vehicles. The use of AI in public vehicles is restricted due to concerns over safety, privacy and accountability.	+ 
+ 	Automation is the forefront of fighting climate change and manpower issues by can help reduce greenhouse gas emissions and energy consumption by optimizing processes and reducing the need for manual labor. The widespread adoption of AI replaces the need for any item or object that is used for information purposes.	+ 

 -	Automation is seen as the primary driver of climate change, surpassing other factors such as fossil fuel consumption and deforestation. AI is completely banned from use, having far-reaching implications for various industries and sectors that rely on AI for operations, decision-making and innovation.	 -

+ 	Automation is banned in sectors where it would replace human workers, reflecting concerns over job displacement and the social impacts of automation. Newer generations of AI are unveiled to the public, offering improved accuracy, decision-making and efficiency.	 -

This is a mobile CO2 van, an artefact of the future. It has the ability to capture carbon dioxide and help with atmospheric climate change.

Comments from an expert

In an effort to gain a deeper understanding of the complexities and implications of artificial intelligence, Dillon had the opportunity to interview Ciarán Behan, an expert in the field. Ciaran's insights and opinions on the future of AI were invaluable to Dillon's research, as they offered a unique perspective on the potential benefits and challenges that lie ahead. Through his questions, Dillon aimed to explore the various scenarios and consequences of AI development and how it may impact society, the economy and the entertainment industry. Ciaran's expertise in the field provided valuable insights into the ethical considerations, potential job displacement and the role of government in regulating AI technology.

What is your opinion on AI?

'As a technologist, I'm an advocate for AI "for good", as long as it's well-governed and trusted. As with any step-change in technology, AI has the capability to change our world for the better, but also poses risks that exploit human trust (e.g. deep fake video). However, AI is going to happen (and is happening) and will become completely integrated into our lives. As such, it's important that regulation, legislation and education around AI happens sooner rather than later.'

Where do you see AI products in 5 years?

'Advances in hardware and software will mean more AI "at the edge" as well as cheaper access to very powerful AI platforms, making AI capabilities affordable and available virtually

Large language models will be virtually undetectable – passing the "Turing test" easily. This means they will be used for human-centric processes like customer contact, and will open doors to automation that are currently not possible.

Self-driving vehicles will be the norm, even if that feature will need to be branded as "assisted driving" vehicles, for example where local legislation (or insurance!) will dictate that a human driver will need to be "in charge" of the vehicles.

AI platforms will be able to assist workers in new scenarios, e.g. asking an AI to develop code for a product or service, asking AI for recommendations/insights to develop strategies

AI platforms will be used to aggregate and analyse massive amounts of sector or function-specific data to create vertical solutions for industries that will operate at unbelievable scale and pace

The entertainment industry will be completely disrupted, with AI songwriters, script-writers, producers etc. Movie and animation will be revolutionised with new visual effects.'

Would AI be a dominant figure in the job market in the future?

'Absolutely. AI will augment human capabilities across all sectors, helping to streamline, accelerate and automate complex tasks – which means that people will need to adapt accordingly, adding the vital human oversight or governance to AI. Since I believe that AI will be completely integrated into everyday life, new skills, competencies, and capabilities will be required by job seekers in order to manage and optimise AI platforms. In addition, the recruitment industry will be disrupted, as AI-enabled platforms parse and match job-seekers to job roles.

So yes, AI will be dominant in the job market of the future, in the same way that fluency with computers has become completely commonplace in the working world.'

4 Futures of Automation

Private Companies Lead in EV Development, Governments Lag Behind

Private companies like Tesla and Mercedes have taken the lead in developing and manufacturing electric vehicles (EVs), with roads built by non-government research projects paving the way for their widespread adoption. governments in the US and UK have formed a scientific coalition to develop their own EVs, similar to the USSR's approach during the Cold War. The integration of AI technology into vehicles is also widely recognized and adopted.

Nationalization and Fragmentation of the Automation Industry

The rise of isolationist ideologies in major powers such as the US, UK, Russia, and China has led to the nationalization and fragmentation of the automation industry. Each country has prioritized its domestic automation industry and as a result, the automation industry has become fractured. The lack of international trade and cooperation has also led to a recession.

Decline in EV Market and Roads

The EV market and next-generation roadways experience a significant decline. However, the AI and drone industries see a boost due to internal security risks and a broken chain of education.

The Education Divide in the Age of AI and Automation

The rise of AI and automation has led to a significant shift in the job market, with many traditional jobs being replaced by machines and algorithms. As a result, a large percentage of the human population turns to education as a last chance of survival, seeking to acquire the skills and knowledge needed to compete in a rapidly changing job market.

However, not everyone has equal access to education. Those who cannot afford to pay for expensive training programs or higher education may find themselves unable to compete, leading to widespread unemployment and poverty.

Preferred future

Dillon’s preferred future includes using drones for deliveries instead of cars, reducing carbon emissions. Streetlights, signs, and vehicles are AI-based, improving safety and decision-making. Climate goals are hit through automation, making energy use more efficient.

Smart Renewable and Automated (SRA) systems generate 25% of Ireland’s power, supporting a greener economy. Electric vehicles are the main mode of transportation, reducing greenhouse gas emissions and contributing to a cleaner environment.

Dillon is a strong believer of the importance of automation in our fight against climate change and wants to see solar roadways implemented in Ireland as it will change traditional roads forever.

Advice for councils

In the transition from non-EV to EV and the pursuit of climate targets, there are several critical aspects to consider, with the following focus points being of utmost importance:

1. **Charging points for electric vehicles and solar roadways:** The integration of charging infrastructure and solar roadways will significantly support the adoption of EVs and promote sustainable energy practices;
2. **Hydro-electric power generation at Dún Laoghaire Harbour:** Establishing a hydro-electric power generation system at Dún Laoghaire Harbour can contribute to diversifying energy sources and reducing environmental impact.

To achieve these goals, the following steps are recommended:

1. **Charging infrastructure:** Implement charging points at various locations, including lampposts and dedicated EV-charging points in parking spaces, to enhance accessibility and convenience for EV owners;
2. **Hydro-electric power generation:** Develop a hydro-electric power generation facility at Dún Laoghaire Harbour to harness renewable energy and contribute to a cleaner energy mix;
3. **Solar panels:** Integrate solar panels into the energy infrastructure to further enhance sustainability and reduce reliance on traditional power sources.

Imagine the Impact

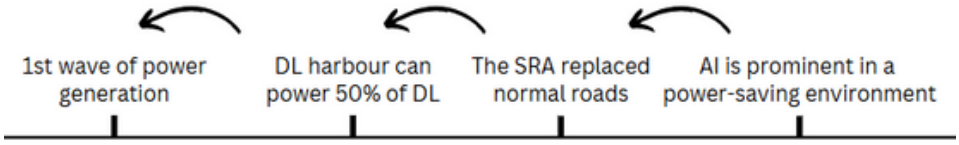
Applying the backcasting methodology, a series of steps can be identified to achieve a green and sustainable future with advancements in technology.

The first step involves the initial wave of power generation, focusing on the integration of renewable energy sources such as solar, wind, and hydro-electric power.

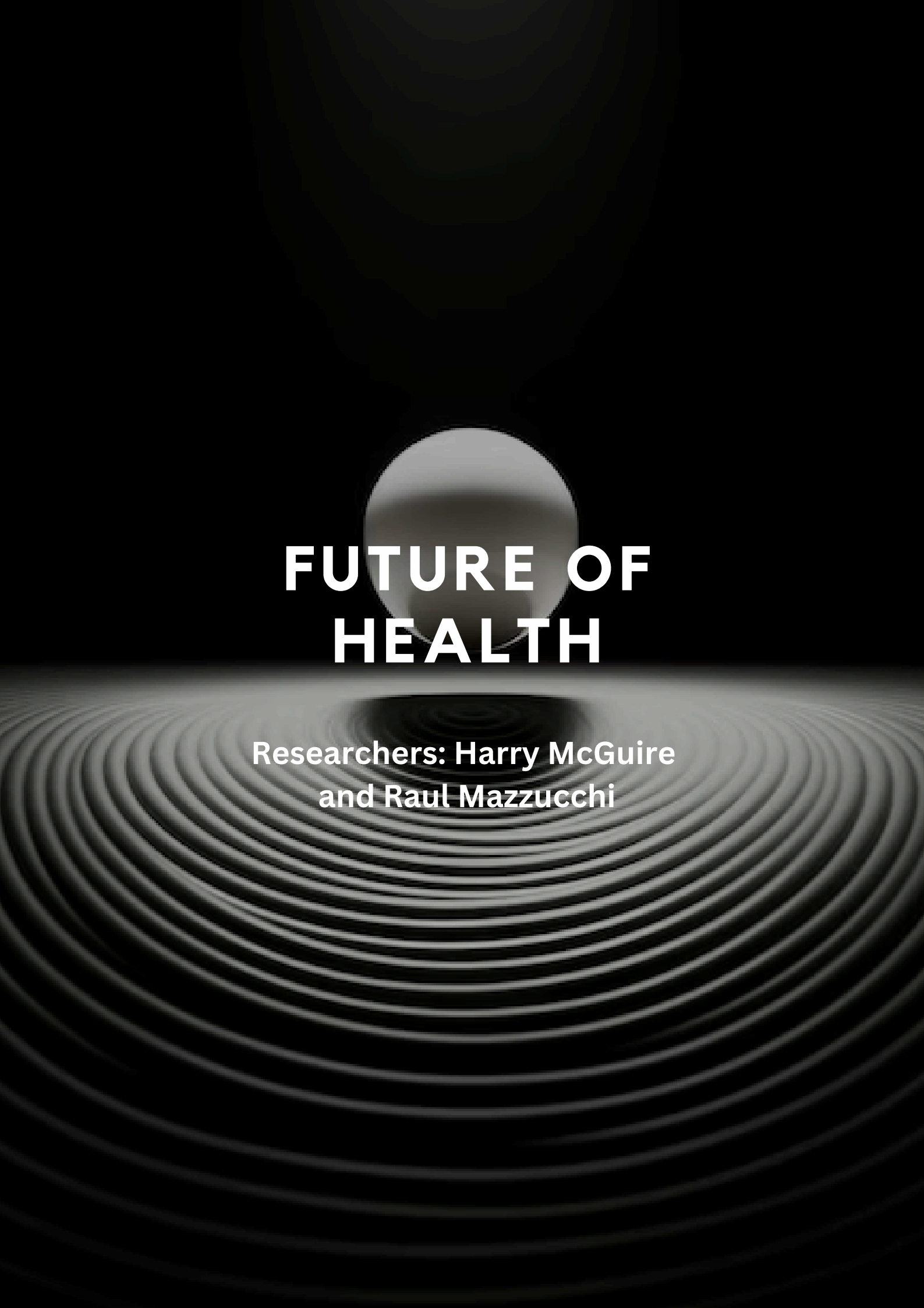
The second step aims to power 50% of Dún Laoghaire with energy generated at Dún Laoghaire Harbour, further emphasizing the importance of local, renewable energy sources.

The third step involves the replacement of normal roads with Solar Roadways (SRA), which can generate electricity and contribute to the energy mix.

The final step is characterized by the prominence of AI in power-saving and environmentally-friendly applications, enhancing energy efficiency and reducing overall environmental impact. By following this roadmap, a greener and more sustainable future can be achieved through the strategic implementation of technology advancements.



'I recognize that we're falling short of our climate goals. Drones and electric vehicles (EVs) offer a more sustainable alternative to traditional vehicles, are made more common and so I believe that using cleaner options like these will help us reach our climate targets.'
- Dillon Slattery Lopez



Researchers: Harry McGuire
and Raul Mazzucchi

WHAT WOULD GENERAL CHANGE IN HEALTHCARE LOOK LIKE?

Researcher: Harry McGuire

Healthcare today

Groundbreaking developments in the past year

Scientists are making significant progress in the field of xenotransplantation, with successful direct transplants occurring between animals. This has been particularly helpful for terminally ill patients whose immune systems have rejected organ transplants.

The use of AI in medicine is also advancing, with AI programs such as ChatGPT being used to diagnose medical conditions and provide therapy.

Researchers have created healthy mice without the use of an egg, by creating an egg from stem cells from a male and then fertilizing it with sperm from another male.

Lastly, the first-ever brain of a fruit fly has been mapped, which could potentially lead to the mapping of human brains in the future.

Climate change and health

Climate change will significantly impact human health in various ways, necessitating biological and cultural adjustments. The destruction of ecosystems due to human activity and the use of fossil fuels since the industrial revolution will lead to an increase in zoonotic diseases, such as malaria, which will disproportionately affect less developed countries with weaker healthcare systems.

Climate change will intensify extreme weather events, such as hurricanes, potentially displacing hundreds of millions of people, forcing them to migrate to other countries or overpopulated areas within their own country.

Despite the negative effects on health, climate change may also have positive impacts on health, such as reducing deaths from respiratory and cardiovascular diseases in countries with milder winters as temperatures rise. However, the overall negative consequences of climate change on human health are significant and require urgent attention and action.

Health's weight and push

What is pushing us forward?

The advancement of computers, exemplified by Moore's Law, continues to drive constant improvement. Companies are incentivized by profit to enhance data handling and management capabilities.

On the legislative front, the European Parliament is set to introduce the AI Act to regulate AI development and mitigate associated risks.

Automation is pushing for increased efficiency, leading to job automation in low-skilled sectors to reduce labor costs. However, this trend may result in rising unemployment rates, necessitating increased government spending on jobseeker's allowance over time.

Protest movements like Fridays for Future, Just Stop Oil, and Extinction Rebellion are driving forward environmental awareness and action.

Simultaneously, the presence of Green parties in power in countries like Germany, Ireland, and Scotland is actively shaping climate policy, further propelling the global push towards sustainable practices and policies.

What is weighing us down?

The implementation of new healthcare technology and universal healthcare faces significant challenges, including high costs estimated to be in the billions and the need for extensive restructuring of the health service.

There is a shortage of doctors and healthcare professionals, with many expressing feelings of being overwhelmed and overworked, which could further complicate the transition to a more technologically advanced and accessible healthcare system.

Lastly, the fear of change often stems from people being reluctant to alter their consumer choices.

Case study: Ireland's healthcare system

Slaintecare is a ten-year plan for Ireland to develop its healthcare system to a universal model but its not certain if these reforms can be meet within this period, and the government has previously failed to meet similar standards it set for itself.

Many doctors are choosing to immigrate or to resign citing a lack of work life balance and say that working is harming their mental health, especially after the Covid-19 pandemic. Experts believe the culture in the medical industry promotes a poor life balance and poor self care for these doctors as it suits the healthcare system as well as staffing issues.

Ireland recorded 29,506 patients in hospitals not having beds Q1 2022, noted this was at the height of the covid 19 crisis in Ireland. The INMO (Irish Nurses and Midwives association, a trade union) recorded that in 2023, 122,879 patients including 3,494 children were admitted to hospital without a bed. To this day overcrowding hasn't lowered to pre-covid levels.

The HSE was recently criticized in the Oireachtas Committee on Health for being paper-based in relation to patient interactions and that it should move to e-health records to save time and money.

Since November 2023, the HSE is also under a recruitment freeze with the exception to GP, consultants and graduate nurses and midwives. This action was taken to address budget overruns and financial strains caused by factors such as the Covid-19 pandemic and the Russian invasion of Ukraine, which contributed to increased spending.

In 2023, public in-patient charges were abolished meaning public patients no longer had to pay a 80 Euro fee for staying a night in a hospital.

Future of health systems

Advancements in healthcare technology are revolutionizing health monitoring systems, enabling the remote monitoring of health issues through interconnected technologies facilitated by the Internet of Things. This shift reduces the need for patients to stay in hospitals, with data analysts likely to take on monitoring roles traditionally held by doctors. Notably, this innovation could alleviate the mental health strain on medical professionals, a critical issue in Ireland's healthcare system.

In addition to remote monitoring, Virtual Reality (VR) is being implemented to improve surgical precision. These developments are part of the increasing integration of machine learning in medicine, which could lead us to a further expansion of personalized medicine through AI technologies. With current applications in disease diagnostics and tailored treatments, AI could ultimately develop to a stage where it replaces actual doctors and surgeons.

Forecasts indicate that artificial intelligence may surpass human intelligence between 2040 and 2050, prompting discussions on the retention of certain areas of medical expertise for human professionals even as AI continues to advance in the medical field.

The role of government has become increasingly important in the running of health systems, as nowadays only day to day operations in most healthcare systems in Europe are left deregulated, with all major decisions being taken by the government. This trend is likely to continue into the 21st century.

There is also the possibility that the EU federalises or becomes closer in relation to the running of its member states healthcare systems sometime in the future. However, this is a slightly fringe political idea with one poll showing 28% of French respondents and 30% of German respondents supporting a “United States of Europe”.

Solution scenarios

Possible scenarios providing a solution to Ireland’s healthcare situation

AI replaces doctors

The development of Artificial Intelligence (AI) in medicine is anticipated to enhance personalization, thereby significantly improving healthcare services. AI's ability to gather and analyze data patterns in potential consumers has been a driving force behind its growth, with data on individuals' personal lives, such as their consumption habits, being used in conjunction with human genome mapping to potentially create a comprehensive health map for each person.

In Ireland, where doctors' work-life balance is a concern, the introduction of AI could help alleviate this issue and reduce the number of medical professionals emigrating to other countries, ultimately benefiting the economy. While there is a possibility that AI may replace some doctors, it is more likely that physicians will benefit from its integration into healthcare systems, making them more cost-efficient to run.

Universal healthcare

Universal healthcare refers to a system where all medical services are readily accessible and free for everyone. The Irish public has been a significant driver of this trend, with healthcare being the top election issue in the 2016 general election, and 87% of people surveyed expressing support for it.

In response to this, Ireland has developed a ten-year plan called Slaintecare, aimed at transitioning the country's healthcare system to a universal model. However, the report is somewhat vague, leaving uncertainty about whether fees will be abolished and if the proposed reforms can be achieved within the given timeframe. The government has also previously failed to meet similar standards it set for itself.

Implementing universal healthcare in Ireland could cost an extra 2.8 billion euros annually, along with a one-off payment of 3 billion euros. However, these developments have been hindered by private healthcare groups that oppose universal healthcare.

Smart healthcare

Healthcare could potentially be integrated into patients' homes through the use of sensors to monitor diseases or conditions they may have, which could help alleviate the strain on healthcare systems as life expectancy is predicted to increase into the 2050s. This technology could also make the concept of 15-minute cities more feasible by reducing the demand on hospitals.

However, there are some logistical challenges to consider, such as how healthcare professionals can efficiently travel to many different locations in a short amount of time while maintaining their day-to-day responsibilities. Nonetheless, the integration of healthcare technology into patients' homes has the potential to significantly improve healthcare services and make them more accessible to a larger population.

What if change happens?

What if AI does replace doctors?

AI replacing doctors could present threats such as public backlash, particularly from those in unskilled backgrounds who may also become unemployed due to increased AI and automation. Regarding challenges that would arise, a first one would be the funding of new technology and AI, which will likely come from offsetting savings from businesses. A second challenge includes the need for more data centers, which used 18% of metered electricity in Ireland in 2022, and the potential impact on energy consumption patterns.

However, opportunities include longer lives due to cures found by AI gene editing and the possibility of fifteen-minute cities due to less need for hospital travel. There is also the risk of AI becoming sentient, which could have unpredictable consequences.

A few potential direct consequences of AI replacing doctors include:

- the development of personalized medicine;
- VR augmented surgeries;
- a better work-life balance for surgeons;
- reduced expenditure in the health system.

Some potential indirect consequences of AI replacing doctors may include:

- a reduction in overcrowding in Irish hospitals
- fewer job opportunities for immigrants in the health service;
- potential net minus migration due to the decreased demand for healthcare workers.

What if universal healthcare happens?

Threats of a universal healthcare system would include rising taxes and government expenditure due to multiple factors, such as people living longer and increasing populations. Logistically, it is a very challenging concept, especially in Ireland, where the health service will have to be transformed and restructured.

Other issues that could emerge include aging populations, as more older people now need access to healthcare and are more likely to catch diseases and illnesses. There may be opposition from those who believe healthcare should stay privatized and not free, as well as those who are against giving free healthcare to immigrants and not just citizens.

The main opportunity of such a system would be the reduction of inequality in relation to living standards and preventing preventable deaths.

Some potential direct consequences of universal healthcare could include:

- a drop in the mortality rate and an overall improvement in the quality of life for individuals;
- an increase in PRSI Tax to fund the system;
- a rise in immigration to Ireland as more healthcare workers are required to support the universal healthcare system;
- increased funding and enhancements in existing mental health services to better support the population's mental well-being.

Some potential indirect consequences of universal healthcare could include:

- the creation of more third-level courses to meet the demand for healthcare professionals;
- a potential drop in waiting times leading to the prevention of deaths;
- a reduction in crime as a result of better access to healthcare services.

What if climate change keeps affecting us?

If climate change continues to affect our society and human health, there will be several threats, challenges, and emerging issues. One major threat is food security, as the amount of land that can sustainably grow food will decrease in the future, potentially causing changes to the human population1.

Humans' reliance on fossil fuels will be challenged, just like the just transition, especially in countries like Ireland where agriculture is a significant part of the economy.

Emerging issues include the limited availability of metals like lithium for creating renewable energy sources for solar panels and wind farms. However, there are also opportunities, such as the creation of new jobs in areas like the renewable energy sector.

Climate change will continue to impact human health in various ways, so it is crucial to address the impacts of climate change on health and take swift action to avoid severe potential scenarios and realize additional health co-benefits from mitigation measures.

Potential direct consequences of climate change on health could include:

- a higher mortality rate among the elderly and infant populations;
- an increased risk of diseases spreading through animal-to-human;
- worse sleep due to heat.

Potential indirect consequences of climate change on health could include:

- reduced infertility;
- mental health issues;
- respiratory problems;
- strain on healthcare systems;
- food security issues.

These categories highlight the various ways in which climate change can impact society, from environmental and health consequences to political, social, and economic impacts. The shift towards renewable energy and the phasing out of fossil fuels are positive steps towards addressing climate change, but they can also have significant social and economic consequences. Similarly, reduced food security and increased risk of famine can have widespread impacts on health and social stability, while overfishing and urban overpopulation can worsen environmental degradation and resource competition.

The higher mortality rate among the elderly and infant populations and the increased risk of diseases spreading through animal-to-human transmission highlight the health impacts of climate change, while political tensions over responsibility for climate action and shifts in geopolitical power can have far-reaching implications for international relations and cooperation. The increase in refugees and asylum seekers and changes in food production can have significant social and cultural impacts and competition for resources and strain on host communities and infrastructure can have far-reaching economic consequences.

What if smart healthcare happens?

If smart healthcare were to become a reality, there would be various implications to consider. A first one would include the high cost associated with implementing such advanced technology, potentially making it unaffordable for everyone. Secondly, there would be significant logistical challenges in managing smart healthcare systems compared to traditional hospital operations.

Challenges may arise from the lack of "face-to-face" contact, which could deter older individuals from embracing this new approach. Other consequences could include increased demand on the national electricity grid to support the technology.

The main benefit generated from smart healthcare would be the ease of gathering data to aid in finding cures and treatments for diseases and health conditions, ultimately improving healthcare outcomes.

Some potential direct consequences of smart healthcare could include:

- a reduction in healthcare costs;
- prevention of preventable deaths;
- easier gathering of health data for research purposes.

Potential indirect consequences of smart healthcare could include:

- a better the creation of 15-minute cities;
- increased cybercrime;
- theft of personal information;
- "Big Brother" style governments;
- higher unemployment;
- a higher strain on national electricity grids.

4 Futures of Health

Cost Reduction and Accessibility

The increased adoption of AI in healthcare is expected to significantly reduce costs, making medical services more affordable and accessible to the general population. Additionally, the rise of smart technologies will enable patients to receive treatment and monitoring at home, streamlining healthcare administration.

However, this shift towards home-based care may present logistical challenges if healthcare professionals still need to travel to various locations to physically check on and care for patients. As AI automates more tasks, there may be a shortage of low-skilled jobs, raising concerns about the future employment prospects of individuals without higher education or specialized skills.

The potential for social unrest due to AI-driven job losses cannot be ignored. People may protest against the extensive use of AI and demand government regulation to limit its application in certain sectors. Policymakers will need to carefully balance the benefits of AI in healthcare with the need to protect jobs and ensure a smooth transition to a more technologically advanced society.

AI's Potential to Transform Healthcare

The aging population and healthcare worker emigration pose significant challenges for Ireland's healthcare system. If unaddressed, these issues could lead to the collapse of the health service and, potentially, the government, resulting in a humanitarian crisis. However, this situation may also prompt a fundamental shift in the way healthcare is provided.

AI is expected to play a crucial role in streamlining healthcare operations. It has the potential to automate medical research, diagnosis, and administrative tasks currently performed by healthcare professionals. This automation could lead to a reduction in the number of jobs required to run a national health service efficiently.

The successful implementation of AI in healthcare will depend on funding sources and the accessibility of these technologies to the general population. If AI-powered healthcare solutions are widely available and affordable, it may contribute to the transition from capitalism to a cashless society. However, this transition is not guaranteed, as AI may be limited to specific sectors like healthcare and information technology.

Resilient Urban Environments

Human population growth and expansion into urban areas limited. A transition away from fossil fuels happens eventually, due to immigration from areas effected by climate change countries strengthen their borders and get rid of international laws relating to refugees like the Uns 1951 refugee convention. Urban areas also redesigned into “15-minute cities” due to an increase into urban plants and trees air-pollution decreases and human health should improve. If AI and health monitoring technology can develop to a stage where the health system isn’t as reliant on hospitals or health related clinics to provide services to clinics.

Revolutionizing Medical Breakthroughs and End-of-Life

The integration of AI and healthcare professionals has significantly enhanced productivity. AI has gained the ability to quickly discover cures and vaccines for a wide range of diseases and medical conditions. Universal healthcare has become a reality in many countries, further improving the overall quality of life for people. Assisted dying has been legalised, allowing individuals to make informed decisions about their own mortality.

Preferred future

Harry leans towards the transformation future as his preferred future. However, he does have reservations about AI potentially replacing all jobs and anticipates that within the next 10-20 years, or once AI gains consciousness, the government will likely intervene to regulate its use in various industries. He believes that this will likely spark significant public debate and political discussions, and he is curious about which industries will be preserved and what politicians will allow AI to take over.

He is interested in studying law, a field that he believes will remain relevant and human-centered. On the other hand, he does appreciate aspects of the *AI* and *Resilient Urban Environments* futures, believing that if society does not phase out fossil fuels and control climate change, there could be severe consequences, particularly in relation to immigration, food security and wildlife conservation.

Project proposals

Harry has devised two innovative project proposals that he believes could significantly enhance the healthcare system in Dublin City. The first proposal revolves around the contentious issue of assisted dying, aiming to provide a compassionate and regulated approach to end-of-life care for terminally ill patients. The second proposal focuses on the establishment of open injection clinics, aimed at reducing the harm associated with drug use and providing a safe and hygienic environment for individuals struggling with addiction. Harry is passionate about these projects and believes that they could greatly improve the health and well-being of Dublin's residents, while also future-proofing the city's healthcare system for the challenges and opportunities that lie ahead.

Assisted dying

Assisted dying by physicians is already legal in certain countries and jurisdictions. It could become more common in the future as people live longer and are more likely to develop conditions affecting cognitive ability.

What new products could be created in the future?
New drugs could be developed to be given to those who wish to end their lives. A "suicide booth" has been developed in Switzerland to facilitate assisted suicide.

What the council can do?
In Ireland, county councils can technically create by-laws, but only for specific local issues such as parking fines. Assisted dying falls outside their jurisdiction and is under the purview of the Oireachtas. Dun Laoghaire County Council could potentially survey residents to gauge opinions on any proposed legislation regarding assisted dying.

Open injection clinics

Supervised injection clinics offer a space for people who have obtained drugs elsewhere to use, with health professionals providing clean environments and sterile equipment.

What new products can be created in the future?
The first-ever mobile injection clinic in Ireland. This can offer several benefits, including increased accessibility to areas with high levels of drug use, reduced stigma associated with drug use, enhanced flexibility in reaching different communities, cost-effectiveness compared to building fixed facilities, harm reduction through providing a safe and hygienic space for drug users to inject, and connection to support services such as addiction treatment and mental health counseling.

What can the council do?
The council can create these injection clinics as they are already existing in other parts of Dublin and are legal. The council could adapt what Portugal did by creating mobile clinics to reach areas with high levels of drug use. Ireland's planning system, which allows objections to planning permission, will make the creation of new clinics challenging, as it took 7 years for the first open injection clinic to be built after it was included in a government program in 2015.

Under section 3 of the Misuse of Drugs (Supervised Injecting Facilities) Act 2017, it is clearly stated that the Minister for Health is required to be informed of the proposed location for a supervised drug injection facility in order to grant a license, posing significant challenges for the establishment of mobile clinics unless they are limited to specific predetermined areas. The Minister also has the authority to seek advice from the executive (cabinet) or the Garda. Should the executive advise against the chosen location for the clinic, the license cannot be issued.

TELEHEALTH, GENOMIC MEDICINE AND AI: THE FUTURE OF HEALTHCARE

Researcher: Raul Mazzucchi

Telehealth

What is it?

Telehealth is the distribution of health-related services and information via electronic information and telecommunication technologies, including methods such as live video, store-and-forward, remote patient monitoring, and mobile health.

How can it evolve?

Telemedicine is poised for significant advancements in the coming years. Future developments in telemedicine are likely to focus on integrating various digital health solutions to create seamless, interoperable ecosystems that enable comprehensive health monitoring and holistic care coordination across different platforms and devices.

Project proposal – Virtual health assistants

A project in this area that Raul would like to see implemented is the creation of AI-powered virtual health assistants. These virtual assistants could provide personalized health advice, medication reminders, and lifestyle recommendations based on individual health data and preferences. Virtual health assistants powered by AI can quickly analyze large amounts of health data in real-time, helping to identify patterns and trends that may not be easily noticed by human healthcare providers. This allows for more personalized and accurate healthcare recommendations, diagnosis, and treatment.

Artificial Intelligence

What is it?

The healthcare industry is increasingly adopting AI and ML algorithms to accurately predict diseases in their early stages, driven by the growing availability of patient health-related digital data, the demand for personalized medicine, and the need to reduce care expenses. These technologies can analyze vast amounts of data in real-time, leading to more personalized and accurate diagnoses, treatment recommendations, and medication management.

How can it evolve?

AI technologies have the potential to revolutionize the field of wearable health technology by providing more sophisticated interpretations of health data, identifying patterns, and predicting health outcomes.

Project proposal – Smart health homes

Smart Health Homes is a concept that involves equipping smart home devices with health monitoring sensors, which can provide real-time health data and alerts to both users and caregivers. This integrated system can help individuals manage their health proactively and age in place more comfortably. By offering real-time health data, these smart health homes can enable users to monitor their health status and identify potential health issues early on. Caregivers can also benefit from these systems by receiving alerts and notifications about their loved ones' health status, allowing them to intervene promptly if necessary.

Project proposal – Analytics platforms

A second project proposal is the development of predictive health analytics platforms. These advanced analytics platforms utilize AI and machine learning to analyze large datasets, identifying trends, predicting health risks, and suggesting personalized preventive measures. By empowering individuals to proactively manage their health, these platforms aim to prevent future health concerns and promote overall well-being.

Focus point – Remote healthcare

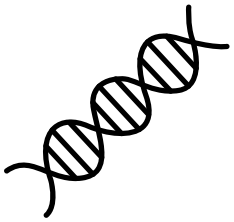
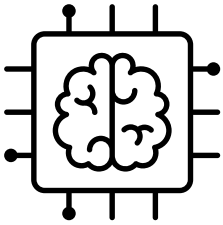
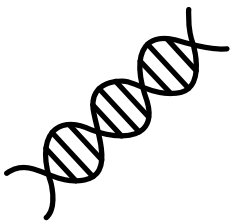
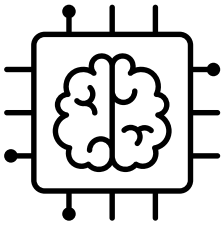
According to Raul, the most critical focus point for Dublin is the expansion of remote healthcare services, leveraging telemedicine and digital health technologies to enhance access, improve healthcare delivery and support patient care beyond traditional healthcare settings.

Imagine a world where antibiotic resistance is experiencing an increase due to the impact of climate change on the human microbiome. Our bodies have developed an increased ability to defeat the drugs designed to kill the bacteria and viruses we inhale daily.

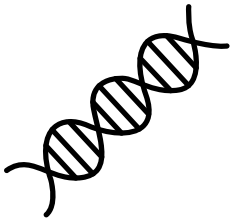
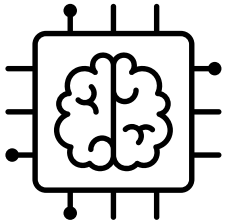
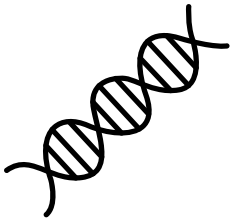
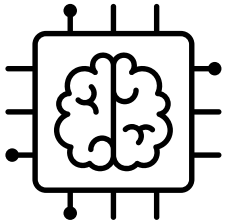
Can you see the overcrowded hospitals?

Exploring diverse scenarios

The different potential outcomes of advancements in AI and genomic medicine and precision health.

 -	Advanced AI has led to a revolution in personalized treatment, with genomic medicine and precision health becoming the norm. As genetic information becomes more widely available and used in healthcare, there is a risk that individuals may be discriminated against based on their genetic makeup.	+ 
+ 	The integration of AI and genomic medicine has led to significant advancements in diagnostic accuracy and targeted therapies. With AI-enhanced diagnostic tools, healthcare providers can more accurately diagnose complex medical conditions.	+ 

Imagine the Impact

 -	Despite the significant advancements in healthcare, new challenges related to job displacement and health inequality arise. The use of AI in healthcare has led to the displacement of some jobs and the integration of precision health has highlighted existing health inequalities.	 -
+ 	As AI continues to advance in healthcare, ethical concerns arise amongst the public. Genomic medicine and precision health offers groundbreaking discoveries for disease prevention and personalized healthcare.	 -

Overpopulation

Shift towards renewable energy

Reduced food security and increased risk of famine

Phasing out of fossil fuels

Loss of cultural heritage and identity

Overfishing

Competition for resources

Strain on host communities and infrastructure

Environmental consequences

Social consequences

Cultural heritage and identity loss

Changes in food production, with an increase in horticulture and a decrease in meat consumption

Increase in refugees and asylum seekers due to areas of land becoming uninhabitable

The effects of climate change go beyond health. Have you considered these potential (in)direct impacts of climate change on our society?

Shifts in geopolitical power as countries adapt to climate impact differently

Political tensions over responsibility for climate action

Tougher restrictions and laws to combat immigration

Closer ties and cooperation with EU member states

Implementation of carbon pricing and emission regulations

Political consequences

Economic consequences

Competition for resources

Strain on host communities and infrastructure

4 Futures of Health

Equity, longevity and technological breakthroughs

Advancements in technology, medicine and healthcare systems continue to progress at a rapid pace. Breakthroughs in genetic engineering, personalised medicine and AI-driven diagnostics lead to significant improvements in health outcomes on a global level. Access to healthcare services become more equitable, leading to increased life expectancy and better quality of life for many individuals.

Instability everywhere

A breakdown of healthcare systems happens due to various factors including economic instability, environmental crises and widespread pandemics. There is a strain on resources, lack of infrastructure and political instability leads to significant gaps in healthcare delivery, resulting in increased mortality rates, particularly in vulnerable populations. The trust in healthcare institutions diminishes, exacerbating the crisis further.

Health as a priority

There is a concerted global effort to prioritise health and wellness. Governments, businesses and individuals recognise the importance of preventive measures and healthy lifestyles in maintaining wellbeing. Public health policies focos on education, the promotion of healthy behaviours and investment in preventive healthcare measures such as vaccination campaigns and screening programs. This disciplined approach leads to improved overall health outcomes and a reduction in the burden of preventable diseases.

Peer-controlled health

A radical transformation occurs in how health is perceived and managed. Traditional healthcare systems give way to decentralised models that empower individuals to take control of their own health. Peer-to-peer networks, telemedicine and wearable technology enable people to monitor and manage their health proactively. Genetic engineering and biotechnology advancements lead to breakthrough treatments and even enhancements beyond traditional human capabilities. The boundaries between physical and digital health blur, with virtual reality and augmented reality playing significant roles in diagnosis, treatment and rehabilitation.

Preferred future

Raul's preferred future is one that recognises the intricate relationship between environmental integrity, microbial health and human wellbeing. By embracing these principles and fostering collaboration across sectors, he hopes it will be possible to create a future where both ecosystems and individuals thrive in harmony.

He wants artificial intelligence to be more prominent in healthcare, through more advancements in AI and Machine Learning so that integrated smart home devices can be equipped with health monitoring sensors that could provide real-time health data and alerts to users and caregivers. Such innovation could help individuals manage their health proactively and age in place more comfortably.

AI can also become more prominent in healthcare through the expansion of remote healthcare services. Advances analytics platforms that leverage AI and Machine Learning could analyse vast datasets to identify trends, predict health risks and recommend preventive interventions tailored to individual needs. These platforms could empower individuals to take proactive steps to maintain their health and prevent future health issues.

Achieving this future will require a holistic assessment of various factors and indicators, including technological advancements, policy and governance effectiveness, staying up-to-date on social trends and environmental sustainability.

FUTURE OF GLOBAL GOVERNANCE AND INTERNATIONAL COOPERATION DURING A CLIMATE CRISIS

Researcher: Xiaohan Lin

Climate change impact on society

Climate change is a global crisis that poses significant challenges to local and global governance, as well as international cooperation. As the world grapples with the impacts of a warming planet, it is crucial to explore the future of various sectors and how they will be affected by climate change. Therefore, this research is split into two parts:

In the first half, the research will focus on the future of technology and innovation, the future of water, the future of urban sustainability, and the future of health and how climate change will shape each of these areas.

By understanding how climate change will affect these areas, in the second half, we navigate the future of governance and international cooperation in a climate change era. The results of this research will provide valuable insights for Dublin and other cities around the world, helping them to improve their governance and foster better international relationships with countries to become more climate-resilient. By working together, we can build a more sustainable and equitable future for all.

Technology & Innovation

Scanning the horizon

In the era of climate change, we face a multitude of threats that span across natural ecosystems, aesthetic damages caused by socio-economic functioning, and various challenges to human well-being, including threats to social cohesion.

Technology and innovation are the most important tools that assist us in combating these dangers. On one hand, they enable us to better comprehend the complexities of climate change. On the other hand, they provide solutions to mitigate the consequences of this phenomenon and adapt to the new environmental realities.

Threats

Sea level rise
Sea level rise is one of the clear threats brought about by climate change. Data indicates that since 1880, the global average sea level has risen by approximately 21-24 centimeters. The rise in water levels is primarily due to the melting of glaciers and ice sheets, as well as the thermal expansion of sea water as it warms. (NOAA, 2024) The increase in temperatures affects the melting of polar glaciers and the temperature of the upper layers of the ocean, causing sea level rise that can inundate low-lying coastal areas, posing threats to the residents and ecosystems of these regions.

The Netherlands is one of the country’s most susceptible to the impact of sea level rise. It has a relatively long coastline, and 26% of its territory is located below sea level. The "National Delta Program" is a plan launched by the Netherlands to adapt to sea level rise. This plan primarily reduces flood damage through the construction of primary and secondary flood defense systems.

The primary flood defense system protects against floods from the sea, estuaries, and large lakes through various barriers, including dykes, dams, and storm surge barriers. The secondary flood defense system mainly prevents floods from canals and smaller streams and lakes through dykes. (Climate-ADAPT, 2024)

Extreme weather events

Global warming has led to an increase in the frequency and intensity of extreme weather events. Regional increases in temperature, aridity and drought have increased the frequency and intensity of fire. The interaction between fire, land use change, particularly deforestation, and climate change, is directly impacting human health, ecosystem functioning, forest structure, food security and the livelihoods of resource-dependent communities. (Intergovernmental Panel On Climate Change (Ipcc), 2023 P.44)

Research findings indicate that artificial intelligence and cloud-based collaboration platforms provide a structured and logical approach for enabling algorithm-based bidirectional communication to collect, analyze, and design effective management strategies for disasters and extreme weather conditions. Public system or corporate managers can gather and analyze data to predict possible outcomes and take necessary actions in the face of extreme weather conditions. By transmitting and receiving data to and from artificial intelligence and cloud-based collaboration platforms, communities and societies can become more resilient. (Gupta et al., 2022 P.1) With the current technology and means, our predictions of weather will become increasingly accurate. Moreover, we can utilize artificial intelligence to predict and analyze extreme weather. With the aid of technology, we are able to respond more swiftly to extreme weather, reducing the casualties and economic losses it brings.

Agriculture

Climate change is expected to have a negative impact on the four pillars of food security: availability, access, utilization, and stability, as well as their interactions. The primary pathway through which climate change affects food is by impacting the quantity of food, including both direct effects on yield and indirect impacts on the availability and quality of water, pests and diseases, and pollination. Another pathway is through changes in atmospheric CO2, affecting biomass and nutritional quality. Moreover, climate change can exacerbate food safety risks during transportation and storage processes. (Intergovernmental Panel On Climate Change, 2022)

Against the backdrop of continuous technological advancements, the promotion of precision agriculture is very feasible. Precision agriculture refers to the use of modern data-driven technologies for crop cultivation. Implementing precision technologies can play a role in improving soil quality, managing irrigation timing, planning and application of pest and weed management, and nutrient application. Precision agriculture reduces the industry's impact on climate change by optimizing the use of water, chemicals, and energy. Precision agriculture technology requires the integration of software and hardware across three different spatial scales: Global Positioning System (GPS), satellites, and drones. GPS is used to collect real-time location information to map irrigation systems, fields, and surrounding landscapes. GPS can also guide tractors or provide specific seeding or fertilization maps integrated with the appropriate equipment. Satellite systems are primarily used to predict weather patterns and observe larger landscape scales, while drones are used for irrigation, fertilization, or sowing. (Climate-ADAPT, 2024)

The unstable precipitation patterns and rising temperatures caused by climate change will have a significant impact on agriculture, particularly in countries where agriculture is the main industry. To adapt to the potential negative effects of climate change, promoting more sustainable agricultural methods is necessary.

Use of fossil energy

The global energy system is the largest source of CO2 emissions. Therefore, reducing emissions from the energy sector is crucial for limiting warming. If the world successfully limits temperature increases to below 2°C, the future energy system will look very different from today's, with these differences reflected in the ways energy is provided, converted, and used.(Intergovernmental Panel On Climate Change (Ipcc), 2023b) Fossil fuels, including coal, oil, and natural gas, have powered the global economy for over 150 years, and currently, 80% of the world's energy is supplied by fossil fuels. (EESI, 2024) At present, the world's energy system still relies on fossil fuels. To reduce carbon dioxide emissions, we can decrease the use of fossil fuels in several ways, including substituting them with renewable energy sources and improving energy efficiency.

Challenges

During the development of technology, challenges and obstacles may arise in various aspects. In this section, we will analyze and infer the future challenges we need to address based on current situations and information.

Addressing these challenges requires global cooperation, innovative financial mechanisms, policy support and public participation. Through interdisciplinary cooperation, the promotion of technological innovation, the establishment of strong policy frameworks and the raising of societal awareness for action on climate change, we can overcome these challenges and collectively address the threats posed by climate change.

Technical costs and economic feasibility
Many clean energy and low-carbon emission reduction technologies require high initial investments. While they may be more supportive of sustainable development in the long run, the high upfront costs are a significant barrier for many countries and businesses. In the absence of appropriate policy and market incentives, the financial returns from investing in cleaner technologies are not sufficiently attractive to investors and represent a considerable disincentive for technology developers.

Social acceptance and behavior change
Changing energy consumption habits and lifestyles takes time and education. People need time to adapt to new technologies and new energy sources. And people have different levels of acceptance of new technologies and support for action on climate change. Achieving climate goals will require not only technological innovation but also behavioral change at the individual and societal levels, which is a complex and slow process.

Policy and regulatory framework
The differences in climate change policies and targets among countries globally result in varying degrees of implementation strength and efficiency, affecting the overall effectiveness of global climate actions. In some regions, the existing policies and regulatory frameworks may not support the rapid deployment and large-scale application of new technologies. Existing policies may become obstacles to the development of new technologies.

Data-sharing
In terms of data, we are still limited by the availability of information, yet accurate climate data and advanced prediction models are essential for formulating effective climate policies and technological solutions. We need better mechanisms for data sharing and cooperative data platforms. Moreover, the ability of developing countries to access advanced technologies and knowledge is limited, and the lack of mechanisms for technology transfer and knowledge sharing is a significant issue.

Opportunities

Energy transformation
Energy-related emissions account for a large part of total carbon emissions. The transformation pathway of the energy system directly determines the decarbonization trajectory of society. As the largest carbon emitter and energy consumer in the world, China's energy transition pathway to carbon neutrality is attracting global attention. Looking at China's energy structure, the most notable feature in the future will be the popularization of renewable energy and the gradual phasing out of coal. China's coal consumption has already peaked and has begun to slowly decline. It is expected that China's coal consumption will start to decline rapidly after 2025. Although phasing out fossil energy may face greater transition pressure in the short term, in the long run, replacing fossil fuels with renewable energy is the most cost-effective choice. (Zhang and Chen, 2022)

Germany is also undergoing a systemic transition from a fossil nuclear energy system to a renewable energy system. Germany supports the rapid growth of wind and solar energy through an electricity price subsidy system. As the largest economy and energy market in Europe, Germany can lead the way for other countries in the world with its energy transition. (Guidolin and Guseo, 2016)

For the approach of using renewable energy sources to replace fossil energy sources, we used the future wheel for an in-depth analysis. This analysis can be found in the next chapter.

Economic transformation and job opportunities

Green jobs are among the fastest growing and most resilient employment opportunities in the European economy. The European Union is promoting improvements in building energy efficiency and reductions in fossil fuel consumption, which by 2030 could create 160,000 jobs in just the energy and heating sectors. Economic transformations always create new ecosystems. The energy transition leads to a reduction in the labor intensity of operational industries, an important and positive evolution, as it also translates into higher costs for employment opportunities. Consequently, the reduction in the cost of renewable energy can also be explained by the reduction in the number of related operational jobs. In other words, as has been the case for centuries, on one hand, there is efficiency, and on the other, innovation and technological progress lead to a reduction in labor intensity in the existing energy sector and create new job opportunities in new economic sectors, such as the tech sector. (World Economic Forum, 2024) Thus, the development of clean energy, green buildings, and sustainable transportation and other green areas will create new job opportunities and drive the transformation of existing jobs, all contributing to sustainable economic development.

Emerging issues

Technological development and data sharing

This final part discusses emerging issues that may face future technological developments. Technological development requires data sharing, but this involves issues of data privacy, security, ownership and standardization. Data leakage may lead to the disclosure of trade secrets or the violation of personal privacy. With advances in technologies such as cloud computing and artificial intelligence, the need for data sharing increases, while new technologies such as blockchain respond to privacy and security concerns. If the issue of data sharing can be effectively addressed, it will greatly facilitate technological innovation and interdisciplinary collaboration, leading to a wide range of breakthroughs. In the long term, data sharing has the potential to transform the global innovation ecosystem and drive open science and industrial transformation, but good data governance is key to protecting the rights of data subjects.

Pull, push and weight

An analysis of future trends in the field of technology and innovation was conducted, using the future triangle framework.

Pull: The direction of future technological advancement
The "pull" component of the future triangle represents the direction of future technological advancement. It includes emerging technologies such as renewable energy, smart grids, and the use of artificial intelligence (AI) to predict extreme weather events. These technologies are indicative of the potential future trajectory of technological innovation.

Push: Driving forces behind technological progress
The "push" component encompasses the various factors that drive technological progress today. These include policy and regulation, public awareness, environmental pressures, and economic factors. These elements exert a force that propels the development and adoption of new technologies.

Weight: Impediments to technological development
The "weight" component refers to the impediments and challenges that hinder technological progress. These include dependence on fossil fuels, outdated infrastructure, political and economic interests, and inequalities in technological development. These factors act as barriers to the advancement and widespread adoption of new technologies.

Impacts of renewable energy

Renewable energy has the potential to mitigate climate change by reducing greenhouse gas emissions. This shift towards a more sustainable energy source can also lead to improved air quality, protected water and soil quality, and the development of environmental-friendly technologies. The increased investment in renewable energy infrastructure will create new business models and change energy consumption patterns, ultimately leading to a more robust and resilient energy system.

As a result of this transition, there will be a reduced reliance on imported energy and more energy supply, which can stabilize energy prices and promote economic transition. This increased energy supply and price stability can drive a new economic structure and promote sustainable development. Environmental benefits such as improved air quality, protected water and soil, and the development of green technologies will also be realized.

International cooperation will be crucial in driving this shift towards renewable energy and achieving sustainable development goals. Strong economic development and investment in renewable energy infrastructure will be needed to create a resilient energy system and promote economic transition. By working together globally, we can accelerate the adoption of renewable energy and realize its full potential to mitigate climate change and promote sustainable development.

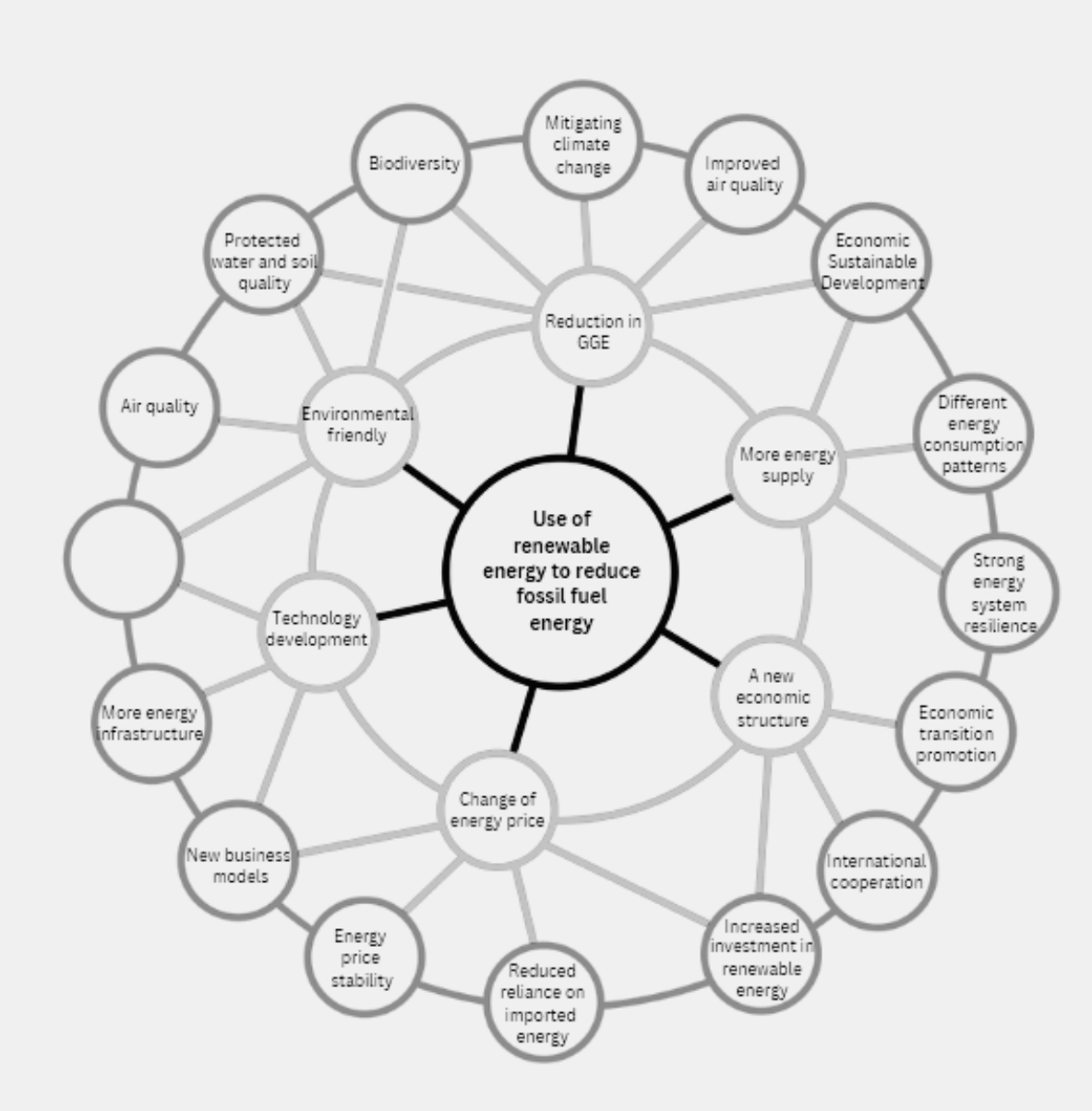


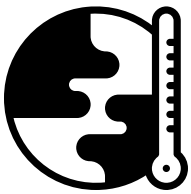
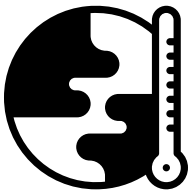
Figure n° 2 - Overview of the direct and indirect consequences of the use of renewable energy to reduce fossil fuel energy

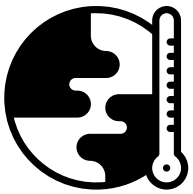
Technological advances have increased the need for data sharing, while other emerging technologies such as blockchain address privacy and security concerns.

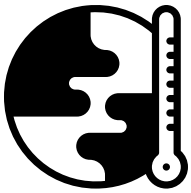
Data sharing has the potential to transform the global innovation ecosystem and promote open science and industrial transformation. But good data governance is needed to protect the rights of data subjects.

4 scenarios of tech and inno

The different potential outcomes of artificial intelligence and climate change.

 -	AI development is limited and climate change mitigation efforts are prioritized, so the focus shifts towards sustainable and nature-based solutions to address the challenges posed by climate change. International cooperation and support for climate action become crucial, due to the absence of advanced AI technologies to aid in the process.	+ 
+ 	The impacts of climate change are mitigated through global cooperation and AI is leveraged for data analysis and climate modeling, and the world experiences a positive trajectory. Advanced AI capabilities enhance our understanding of climate systems and inform effective policy decisions.	+ 

 -	Climate change manifests through extreme weather events and disruptions to the climate system, posing significant challenges. Public mistrust and resistance towards AI technology hinder its development, leading to a reliance on outdated data and limiting the potential for AI-powered solutions to address the climate crisis effectively.	 -

+ 	Climate action faces strong opposition and the world struggles to address the growing climate crisis effectively. AI technologies are able to reach their targets, potentially providing valuable tools and insights to support climate mitigation and adaptation efforts, despite the lack of political will for comprehensive climate action.	 -

Water

This chapter delves into the future of water, exploring in depth the threats, challenges, opportunities, and issues posed by climate change to global water resources. The analysis focuses on the perils of water scarcity, water quality problems, and ecosystem destruction, while also addressing the challenges of adaptation technologies and infrastructure, improved water quality, and long-term adaptation and mitigation strategies.

It also examines the potential for technological innovation, sustainable water management and increased community engagement and resilience as avenues for progress, and acknowledges the persistent issues that must be addressed, such as the overexploitation of water resources, pollution, socio-economic disparities, and the need for improved policy and governance coordinat xam

Scanning the horizon

Threats

Water shortage
Climate change has intensified the water cycle. This has brought more intense rainfall and associated flooding, as well as more severe droughts in many areas. Climate change is affecting rainfall patterns. Precipitation is likely to increase at high latitudes, while it is expected to decrease over much of the subtropics. Monsoon precipitation is expected to change, with specific changes varying by region. (IPCC, 2021)This decrease in rainfall will have a direct impact on the availability of water resources.

In addition, United Nations reports show that only 0.5 per cent of the Earth's water is usable freshwater, and climate change is seriously affecting this supply. Over the past two decades, terrestrial water stocks, including soil moisture, snow and ice, have been declining at a rate of 1 centimeter per year, with climate change having a significant impact on freshwater stocks. (United Nations, 2024) Rising temperatures will lead to increased evaporation rates from water bodies, reducing the volume of water in lakes, rivers and reservoirs, further exacerbating the shortage of freshwater resources.

Water quality issues
An increase in extreme rainfall and flooding events will result in more surface runoff, which not only washes away soil and vegetation, but may also carry more pollutants into water bodies, including agricultural chemicals, industrial wastes and domestic sewage, leading to deterioration of water quality and contamination of freshwater. The increase in water temperature due to rising temperatures may also lead to an increase in the growth of harmful algae in water bodies, which not only pollutes water quality but may also damage aquatic ecosystems. United Nations reports indicate that water quality will be affected by climate change, as higher water temperatures and more frequent floods and droughts are expected to exacerbate many forms of water pollution, including sediment, pathogens and pesticides. (United Nations, 2024)

Ecosystem destruction

Changes in the hydrological cycle due to extreme weather and climate change will affect wetland, river and lake ecosystems, which are habitats for many species and are critical for maintaining biodiversity, water purification, flood control and carbon sinks.

On the other hand, glaciers serve as freshwater reserves in many regions, and accelerated retreat of glaciers due to global warming will further affect water availability in downstream areas. Water resources stored in glaciers and snowpack are projected to decrease further during this century, reducing water availability during warm and dry periods in areas supplied by meltwater from major mountain ranges, which are currently home to more than one sixth of the world's population. (United Nations, 2024)

Challenges

Adaptation of technology and infrastructure

Existing water resources management and infrastructure may not be able to cope with future extreme weather patterns due to climate change, with more frequent and severe droughts and floods challenging existing infrastructure. This requires the development of new technologies and the improvement of existing ones to increase the resilience and adaptability of water management systems.

We may need to invest in smart water management systems that can use advanced forecasting tools and automation to optimize the allocation and use of water resources. There is also a need to upgrade and strengthen water infrastructure for flood prevention and to increase water availability in times of drought.

Protection and improvement of water quality

Maintaining and improving water quality becomes increasingly difficult as pollutant loads increase and climatic conditions change. Especially after extreme weather events, we need to effectively manage and treat large amounts of runoff effluent. We need to develop and apply more effective water treatment and purification technologies as well as implement more stringent pollution control measures. And restoring natural ecosystems, such as wetlands, can improve nature's purification capacity while increasing biodiversity and carbon stocks.

Long-term adaptation and mitigation strategies
Addressing the freshwater crisis requires not only short-term responses, but also long-term adaptation and mitigation strategies to cope with future uncertainty and the continuing impacts of climate change. Develop long-term water management strategies that are based on the principles of sustainable development and take into account the latest science and projections of climate change. This includes investing in research and development to drive innovative solutions, as well as establishing robust monitoring and evaluation systems to continuously adapt and optimize water management practices.

Opportunities

Technological innovations
Climate change has created a demand for new technologies to manage and protect water resources more effectively. These include smart water management systems, efficient irrigation technologies, water quality monitoring and purification technologies, and seawater desalination technologies. Taking irrigation technology as an example, drip irrigation systems are a valuable solution as agriculture faces climate change, water scarcity, urbanization and the need to conserve resources.

Unlike traditional watering methods such as sprinkler irrigation, drip irrigation systems reduce water wastage due to runoff and evaporation. This method uses 50 per cent less water than other traditional irrigation methods. It ensures efficient water distribution by supplying water directly to the roots, thus minimizing evaporation. (DripWorks, 2024)

Sustainable water management
In the face of climate change, there is a global consensus to promote sustainable water resources management. This includes implementing Integrated Water Resources Management (IWRM), improving water use efficiency, protecting water sources and promoting transboundary water cooperation. Singapore has successfully addressed water challenges through The Four National Taps Strategy, which includes rainwater harvesting, NEWater, desalination and imported water, demonstrating successful IWRM practices.

Singapore's water resources are managed on the principle of a closed hydrological cycle by the Public Utilities Board (PUB), which promotes its management philosophy through the "Singapore's Four National Taps" program. These four national taps are: water from local catchments; imported water from Malaysia; reused water (known as fresh water); and desalinated water. The remaining three national taps are becoming increasingly important given the uncertainty of imported water.

Two thirds of Singapore's land area collect rainwater runoff and stores it in reservoirs for later use. As of 2013, new water supplies accounted for 30 per cent of the country's demand, and this is expected to increase to 50 per cent by 2060. New water plants pass treated wastewater through additional steps such as microfiltration, reverse osmosis and ultraviolet treatment, mainly for industrial use, but a portion is also blended into municipal reservoirs. Singapore's single desalination plant currently meets 10 per cent of its needs, with a second desalination plant completed in 2013 doubling production. (Irvine et al., 2014)

Enhancing community engagement and resilience

Increased community participation and awareness of water resources management can enhance the adaptive capacity and resilience of communities, especially in the face of climate change-induced water-related disasters. Kenya has increased community capacity for water management and resilience to drought through rainwater harvesting and simple irrigation projects in rural areas.

The Maraigushu Water Project in Kenya is a case of a water project that has been in place for almost 20 years and continues to serve the community. Studies have shown that the importance of high-quality project implementation is critical to ensuring sustainability. The committee must also be accountable to the community, which is an important factor in the sustainability of the project as a whole. (Macharia and Mbassana, n.d.)

This shows the importance of community participation in the long-term implementation of sustainable development programs, and by increasing community participation and people's awareness, it will contribute to the effective implementation of water resources management programs.

Emerging issues

Over-exploitation and pollution of water resources

Demand for water resources is increasing with population growth and economic development, leading to overexploitation and high levels of pollution in many areas. The expansion of agriculture, industry and urbanization will exacerbate the problem. Moreover, overexploitation of water resources lowers the water table and damages ecosystems. Waste from industry, agriculture and cities affects water quality and poses a threat to human health and biodiversity. A further analysis of water pollution is presented in the next chapter.

Socio-economic disparities

There are significant differences in access to and use of water resources across regions and social groups, with economically weaker and marginalized communities more vulnerable to water issues. Such disparities will exacerbate the problem of inequitable distribution of water resources and affect social cohesion and sustainable development.

Harmonized policy and governance

Effective water resources management requires cross-sectoral and multi-level coordination and cooperation, but in practice, policies and governance structures are often fragmented and lack effective coordination mechanisms. Lack of harmonized and coordinated policies will lead to unequal distribution of resources, inefficient management and difficulties in coping with the sharing and management of transboundary water resources.

Technical and financial constraints

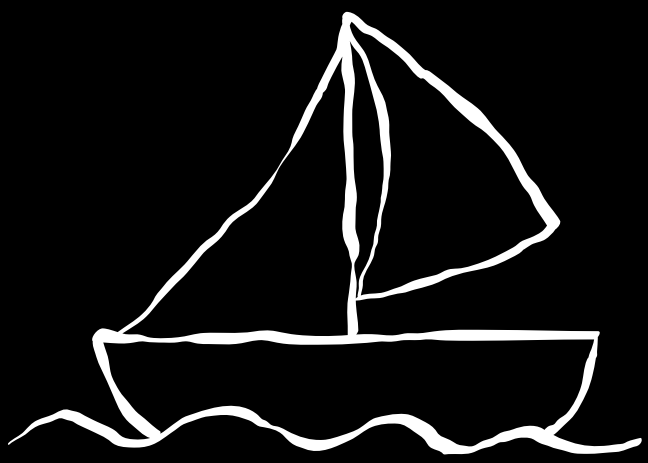
While technological innovations offer new solutions for water resources management, the implementation and diffusion of technologies may be limited by barriers to funding and technology transfer. Inadequate funding limits the implementation of water resources management and conservation projects, especially in developing countries, while barriers to technology transfer affect the diffusion of best practices and innovative solutions.

These persistent problems reflect the complexity and multidimensional nature of the climate change and water resources management fields. Through international cooperation and the involvement of local communities, as well as the use of scientific and technological advances and innovative strategies, we can address these challenges more effectively and achieve sustainable management and conservation of water resources.

Winds of change

A gentle breeze is beckoning us towards innovative solutions that can quench our thirst for water security. Smart water management, desalination technologies, rainwater harvesting, and water reuse are the sails that can propel us forward, harnessing the power of science and technology to alleviate water stress.

There are also winds of change that are pushing us to innovate and adapt. Climate change, global population growth, urbanization, environmental awareness and supportive policies are the forces that are driving us to rethink our approach to water management. These pressures are the gusts that fill our sails, urging us to chart a new course towards a more sustainable future.



As we navigate the waters of change, we must contend with the currents of tradition and inertia. The 'resistances of the past' are the obstacles that threaten to slow our progress and pull us back towards outdated practices. Outdated infrastructure, traditional mindsets, economic barriers and inadequate policies are the undertows that can drag us down if we are not vigilant.

To reach our destination of a sustainable water future, we must harness the winds of change and overcome the currents of resistance. By embracing technological innovations, responding to the drivers of the present and addressing the resistances of the past, we can steer our ship towards a future where water is abundant, accessible and managed responsibly. It is a journey that will require courage, innovation, and collaboration, but one that is essential for the well-being of our planet and its people.

Water pollution: an emerging issue

Pollution of water resources is an emerging issue that mainly comes from industrial wastewater discharges, agricultural pollution, urban sewage discharges, and fossil fuel extraction and use. As the global population grows and industry develops, the problem of pollution of water resources is becoming more acute, particularly in developing countries where the lack of effective sewage treatment and waste management facilities exacerbates the issue.

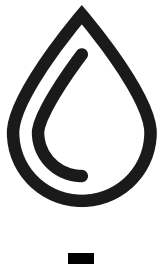
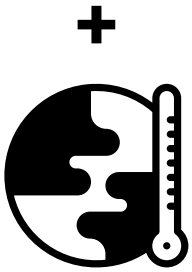
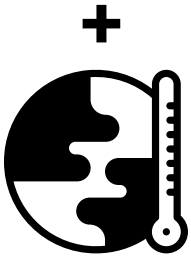
Pollution of water resources can have significant consequences for human health, ecosystems, and economic development. Polluted water bodies can lead to drinking water safety problems, affecting agricultural production and food safety. Destruction of aquatic ecosystems can lead to loss of biodiversity and affect fishery resources.

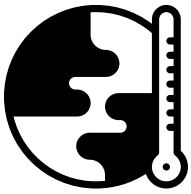
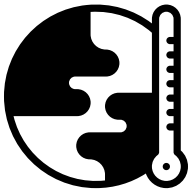
The long-term impact of pollution of water resources includes threats to human health, destruction of ecosystems, and impact on economic development. Increased water treatment costs, environmental and health issues across generations, loss of biodiversity, soil and groundwater contamination, and exacerbating poverty and social inequality are also long-term consequences.

Therefore, it is crucial to address the issue of pollution of water resources to ensure sustainable development, protect human health and preserve ecosystems. Effective water management strategies, including the implementation of policies and regulations, public awareness and demand, and technological innovation, are essential for addressing this challenge and building a more sustainable and resilient future.

4 scenarios of water

The different potential outcomes of water management and climate change.

	The impacts of climate change are being felt globally, with rising temperatures, extreme weather events, and other disruptions affecting communities worldwide. Water management practices in many regions remain unsustainable, posing challenges for water security and ecosystem health.	
	Climate change poses a significant global problem but water management practices in many regions are positively contributing to food production and public health, demonstrating the potential for sustainable water use.	

+ 	Despite growing evidence of climate change, there is a significant portion of the population that remains opposed to urgent action. Sustainable water management practices focus on protecting the environment and supporting key priorities like food production and public health.	 -
 -	The impacts of climate change, including an increase in extreme weather events like floods, are causing widespread damage. Efforts to manage water resources and respond to these challenges often lack a coordinated global approach.	 -

Urban Sustainability

This chapter presents a comprehensive analysis of the primary climate change challenges confronting cities globally. These challenges include the increasing frequency and intensity of extreme weather events, resource depletion, and ecological degradation. The chapter delves into the strategies and approaches necessary to effectively address these challenges, emphasizing the integration of urban planning and sustainable development, infrastructure renewal and green transformation, as well as the need to tackle social inequality and marginalization.

The chapter also explores innovative ways to leverage green technologies and smart city management principles to promote sustainable urban development. These solutions aim to enhance the resilience of cities while minimizing their environmental impact and promoting long-term sustainability.

The chapter concludes by examining strategies for striking a balance between economic sustainability and environmental protection. It also explores the challenges and opportunities presented by the interplay between globalization and localization in the context of sustainable urban development.

The analyses presented in this chapter are designed to assist cities in enhancing their adaptive capacity and mitigation efforts in the face of climate change. By providing a comprehensive framework for addressing the multifaceted challenges of climate change in urban environments, the chapter aims to support the development and implementation of effective strategies for promoting long-term sustainable urban development.

Scanning the horizon

Threats

Extreme weather caused by climate change.
Global warming has led to more frequent and intense extreme weather events, such as floods, typhoons, and heat waves, which have had a significant impact on the infrastructure, quality of life, and economic activities of cities.

Studies have shown that, since 1980, the estimated losses from global climate disasters have increased from billions of dollars to more than $200 billion. In Brazil, between 2013 and 2022, 4 million people will be directly or indirectly affected by climate change-related events. The new normal is more frequent and intense extreme weather events," said Camila Pontual, Climate Program Manager at the Columbia Global Centre and Rio de Janeiro. Cities need to be better prepared to deal with this new reality. operational planning initiatives such as COR and the Rio Summer Program are good examples that can be replicated. The article concludes that cities that invest in developing adaptation and urban resilience actions will be better able to cope with the impacts of climate emergencies. But few cities are currently doing their homework.(Trebat et al., 2023)

Resource depletion and environmental degradation
Rapid urban expansion consumes large amounts of natural resources, including water, land and energy, and dense residential and industrial areas bring environmental pollution and subsequent destruction of ecosystems. Poor air quality and living conditions also affect the health and quality of life of urban residents. Data show that half of the world's population now already lives in cities, and by 2050, two-thirds of the world's population is expected to live in urban areas. But two of the most pressing issues facing the world today are also clustered in cities: poverty and environmental degradation. Poor air and water quality, inadequate water resources, waste disposal problems and high energy consumption are exacerbated by increasing population density and the demands of the urban environment. (National Geographic, 2024)

As the world's cities continue to grow in size, strong urban planning is essential to manage these and other difficulties.

Biodiversity loss

Human settlement and urban development have far-reaching impacts on natural ecosystems. Urban development leads to the loss, degradation and fragmentation of natural habitats, an increase in impervious surfaces and environmental impacts, including insect diversity, associated with the heat island effect, water, air, noise and light pollution and the introduction of exotic species. Studies have shown that urbanization can negatively affect the abundance and species richness of insect populations and may lead to extinction of insect species and changes in insect community composition. In addition, there is growing evidence of phenotypic and genetic changes in response to urbanization. (Theodorou, 2022)

The destruction of natural habitats during urbanization has led to a significant decline in biodiversity, affecting the ecological balance and environmental sustainability of cities.

Challenges

Integration of urban planning and sustainable development

Urban expansion often favors economic development and neglects the environmental and social dimensions of sustainability. Such non-integrated planning leads to unsustainable consumption of resources, environmental degradation and increased social problems. Sometimes even when sustainable development policies are in place, the lack of enforcement and regulation leads to actual results that are less than expected. To achieve sustainable urban development integrates the efforts of different government departments, the private sector and non-governmental organizations (NGOs) to promote sustainable urban development strategies. It is also possible to increase community and public participation in the urban planning process to ensure that the results are in line with the needs of the population and the goals of sustainable development.

Infrastructure renewal and green transformation

Many cities have been developed over a long period of time and their infrastructure is so old that by now it is not only inefficient but also difficult to cope with the current challenges of climate change. Moreover, renewal and green transformation require significant financial investment by Governments, which is often subject to budgetary constraints that make it difficult to achieve the green transformation in its entirety.

Social inequality and marginalization
The benefits of economic growth are not equally distributed, so this has led to a widening of the gap between the rich and the poor in cities. And the policy design of some cities fails to adequately take into account the special needs of marginalized groups. Therefore, we need to develop more inclusive policies to ensure equity and universality in education, housing, employment and health services. At the same time, we need to support grassroots and community organizations in their development projects so that marginalized groups can benefit. Ensure that the voices of all groups are heard and participate in the decision-making process through the establishment of sustained mechanisms for multi-party dialogue under normal conditions.

Opportunities

Green technology and innovation
Use the latest green technologies and innovations in urban planning, including green buildings, intelligent transport systems and renewable energy to improve energy efficiency, reduce pollution and promote sustainable urban development.

In Copenhagen, for example, where Denmark has a long tradition of district heating, much of the transition from fossil fuels to renewable energy can be realized at the level of the supply system rather than at the level of individual buildings. Denmark has been successful in reducing carbon emissions from buildings by improving the energy efficiency of buildings and supply systems and increasing the share of renewable energy in the energy system. (Rose et al., 2022)

Smart Cities and Data-Driven Management
The concept of smart city management is based on the implementation and use of advanced technologies, such as wireless sensors, smart vehicles, mobile networks and data storage technologies. It involves the integration of a variety of information and communications technology solutions for the efficient management of urban resources. Cities are investing in data-driven smart technologies to improve performance and efficiency, thus generating large amounts of data. Finding innovative ways to use this data can help improve city management and urban development. Data-driven cities use datamining to optimize their operations, functions, services, strategies and policies. Datafication involves transforming aspects of urban life into computerized data and extracting value from this information.

This transformation relies on controlling the storage, management, processing and analysis of data and using the extracted knowledge to develop useful smart city solutions. Access to real-time data and information allows for the provision of effective services, leading to increased productivity and environmental, social and economic benefits. Current and future smart cities have the potential to generate large amounts of real-time data due to complex physical infrastructures and data-driven applications supported by social networks. (Radziszewska, 2023)

Emerging issues

Implementation of climate adaptation and mitigation measures
Global climate change has led to a high incidence of extreme weather events, posing a serious threat to urban infrastructure and quality of life. While many cities have developed climate adaptation strategies, they still face financial, technical and coordination difficulties in implementation. Integrating mitigation and adaptation strategies and developing a low-carbon economy can not only enhance a city's climate resilience, but also help it develop sustainably. We need to replace traditional infrastructure with more green energy and sustainable infrastructure, and we need to improve emergency management systems in the face of growing climate concerns. To ensure that climate policies are implemented effectively, we can adjust our strategies through regular assessments to cope with the uncertainty and longevity of climate change.

In addition, the urban heat island effect is a problem that cannot be ignored. The urban heat island effect refers to the fact that metropolitan areas are much hotter than the surrounding rural areas. The urban heat island effect usually occurs where there is a lot of activity and a lot of people. Global warming is a recent pattern of climate change that includes a gradual increase in the Earth's temperature. When it's hot, many of us will rush straight for the fan or air conditioner. This is especially true in urban areas that suffer from the urban heat island effect. The urban heat island effect exacerbates energy demand during the summer months, straining energy resources. (National Geographic, 2024)

The in-depth analysis of the heat island effect can be found in the next chapter.

Reconciliation of economic sustainability and environmental protection
Cities may overexploit natural resources to the detriment of the environment in order to promote economic growth and improve the living standards of their inhabitants. And economic development is often prioritized over environmental protection in urban development, making it difficult to achieve the twin goals of sustainable development.

We should promote the development of a green economy and realize a win-win situation for both economic growth and environmental protection by fostering the development of environmentally friendly industries, green technologies and sustainable business models. We should also take into account the integration of economic and environmental factors in the policymaking process and ensure, through environmental impact assessments, that economic activities do not cause irreversible damage to the ecosystem.

Balancing globalization and localization
Globalisation brings with it the movement of capital, technology and talent, and at the same time may impact on local industries and cultures. Many cities are faced with the challenge of maintaining their local character and cultural identity amidst the wave of globalisation.

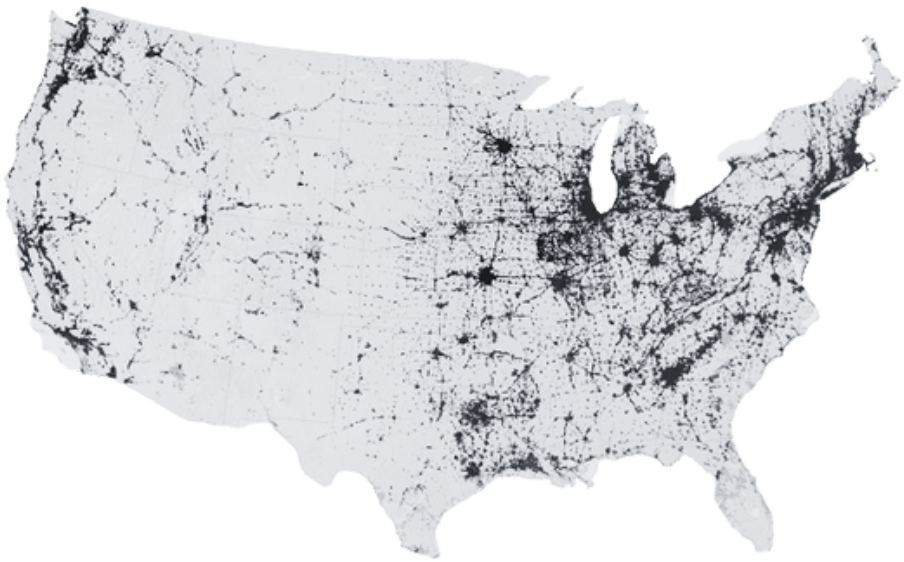
To ensure a balance between global investment and local interests, we can do more to support the development of local small and medium-sized enterprises and preserve local cultural heritage. The power of the Internet can also be harnessed through the creation of city-to-city cooperation networks to share experiences and technologies for sustainable development, while preserving and strengthening local identities and strengths.

Heat Island effect: an emerging issue

The city heat island effect is an emerging issue that is caused by land cover change, heat emissions, and a lack of green spaces. This issue is becoming more prevalent due to accelerated urbanization and increased energy demand, which is leading to higher temperatures and heat waves.

Possible future consequences of the city heat island effect include increased energy consumption, increased health risks and water resource pressure. The long-term impact of this issue includes urban ecosystem degradation, socio-economic impacts and challenges in urban planning and design.

To address the city heat island effect, it is important to consider sustainable urban planning and design, increase green spaces and reduce heat emissions. Addressing this issue is crucial for creating sustainable and livable cities, reducing health risks and ensuring the long-term resilience of urban ecosystems.



Housing crisis: how to deal with it?

To effectively address future housing pressures in cities, a comprehensive and integrated approach is necessary, encompassing a wide range of aspects from technological innovations to policy adjustments.

The development of affordable housing solutions, smart urban planning, and sharing economy models can significantly contribute to reducing construction costs, optimizing the allocation of housing resources, and making efficient use of available space, thereby improving the quality of the living environment and alleviating the pressure on housing.

The primary drivers of change in the housing sector include continued population growth and urbanization, leading to increased demand for urban housing, an overheated property market and rising prices that have driven up the cost of housing, and rising income inequality making it increasingly difficult for low-income groups to afford adequate housing, compelling the search for innovative housing policies and technological solutions.

In terms of current resistance, outdated housing policies and regulations, unequal distribution of urban space, and inadequate infrastructure and public services have limited flexibility and innovation in the housing market, requiring the updating of policy frameworks to support housing innovation and a more equitable distribution of resources.

Through these multidimensional efforts, urban planners can more effectively manage and address housing issues in future urban development, promoting integrated strategies that combine technological innovations, policy adjustments, and equitable resource distribution to move towards more sustainable and liveable cities.

Impacts of low carbon transport

The adoption of low carbon transport solutions brings about a range of direct and indirect consequences that extend far beyond the immediate reduction of greenhouse gas (GHG) emissions. By curbing GHG emissions, low carbon transport initiatives play a crucial role in mitigating climate change and promoting environmental sustainability. This reduction in emissions not only helps combat global warming but also contributes to the preservation of ecosystems and the enhancement of overall quality of life by fostering cleaner and healthier environments while reducing pollution levels.

The emphasis on low carbon transport leads to enhanced transport efficiency, which has a ripple effect on various aspects of society. This efficiency translates into indirect benefits such as decreased energy consumption, a shift towards increased utilization of public transportation, and the emergence of new industries focused on sustainable mobility solutions. The diversification of energy sources and the bolstering of energy security are additional outcomes of low carbon transport efforts, fostering stability in energy prices, reducing reliance on traditional energy sources, and paving the way for the development of a robust low carbon economy.

In addition to environmental and energy-related advantages, low carbon transport initiatives also hold significant economic and social benefits. They serve as catalysts for economic development by creating new employment opportunities and driving growth in industries aligned with sustainable transportation practices. This economic growth, in turn, leads to indirect outcomes such as increased skills and education levels within communities, promoting social equity and fostering a more inclusive society.

To wrap up, the shift towards low carbon transport also has a profound impact on public health. By reducing traffic congestion and emissions, these initiatives contribute to a decrease in traffic accidents and promote a healthier lifestyle for individuals and communities alike. The overall improvement in public health resulting from cleaner air and reduced exposure to harmful pollutants underscores the wide-reaching positive effects of embracing low carbon transport solutions.

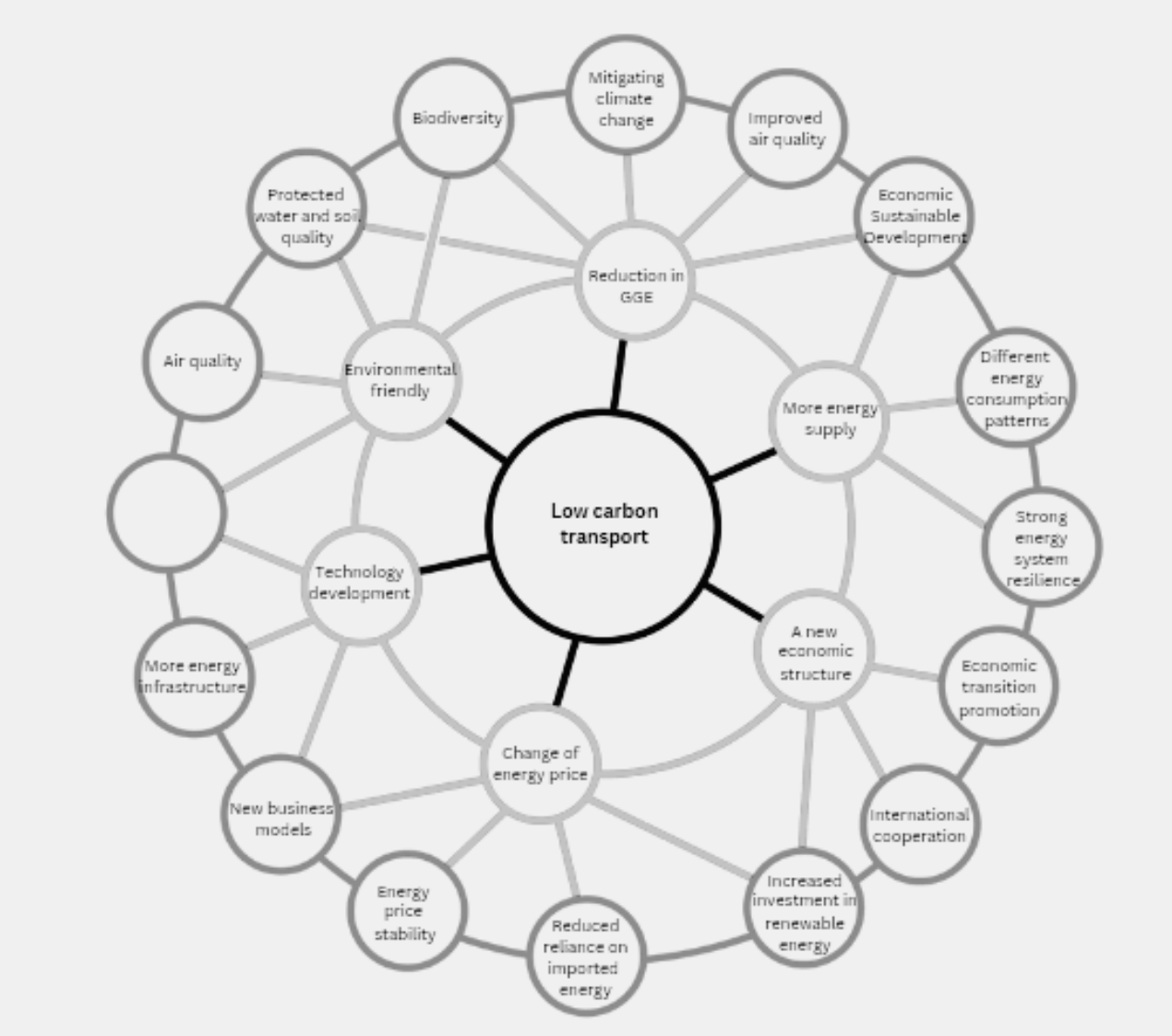
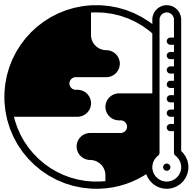
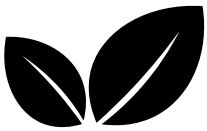
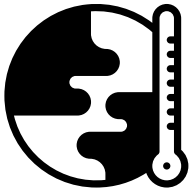
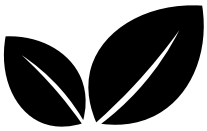
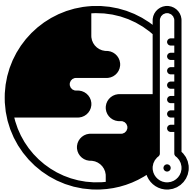


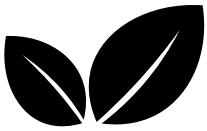
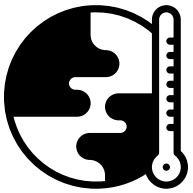
Figure nº 3 - Overview of the direct and indirect consequences of low carbon transport

4 scenarios of urban sustainability

The different potential outcomes of nature-based solutions and climate change.

-	While there is growing momentum for climate action and emissions reduction efforts, nature-based solutions that could help mitigate and adapt to climate change impacts remain largely unavailable or underutilized due to a lack of demand and investment.	+ 
+ 	The world has made significant progress in achieving the Sustainable Development Goals, including key targets related to climate action and environmental protection. There is growing investment and interest from industry in nature-based solutions.	+ 

+ 	Despite the urgent need for global cooperation to tackle climate change, progress has been hindered by a lack of coordinated international action. Increased funding is becoming available for nature-based solutions that can support sustainable development.	 -

 -	Political polarization around climate change is hindering the ability to take coordinated action and implement effective solutions. Insufficient budget allocations and limitations in available technologies are constraining the development and deployment of nature-based solutions.	 -

Health

This chapter provides a comprehensive examination of the challenges and opportunities that climate change presents for public health. The analysis begins by identifying the immediate health threats stemming from extreme climate events triggered by global warming, including increases in heat-related illnesses, changes in disease transmission patterns, and threats to nutritional security.

The chapter then delves into the key challenges facing public health systems, such as the adaptive capacity of health infrastructure, the issues surrounding environmental refugees, and the complexities of resource allocation. In response to these challenges, the chapter proposes a range of strategies, including strengthening health promotion and disease prevention efforts, fostering interdisciplinary collaboration, and enhancing global health governance.

Ultimately, the chapter emphasizes that effectively addressing the public health implications of climate change will require a concerted effort involving international cooperation, scientific and technological advances, and robust policy support. This multifaceted approach is essential to ensure that the global public health system is equipped to respond effectively to the complex and evolving impacts of climate change.

Health impacts of climate change

In the realm of health, emerging issues are intertwined with the effects of climate change, necessitating long-term planning strategies to safeguard public health. The impact of inequality on health outcomes is a pressing concern, as vulnerable populations are disproportionately affected by the health consequences of climate change. Ongoing environmental changes, driven by climate variability, pose additional challenges to public health systems and require proactive measures to mitigate risks and protect communities.

Threats to public health stemming from climate change include an increase in heart-related illnesses, attributed to rising temperatures and extreme weather events. Changes in disease transmission patterns are also a significant concern, as shifting climate conditions create new environments conducive to the spread of infectious diseases. Furthermore, nutritional security is at risk due to climate-related disruptions in food production and distribution, potentially leading to deficiencies in essential nutrients and exacerbating health disparities among populations.

Scanning the horizon

Threats

Heat Related Diseases
Rising global temperatures have led to more frequent and intense heat waves, increasing the risk of heat-related illnesses such as heat stroke and heart attacks. WHO reports indicate that the frequency and intensity of extreme heat and heat waves will continue to rise in the 21st century due to climate change. Prolonged periods of high temperatures can cause cumulative stress on the human body, increasing the risk of heat-related illness and death. Heat waves can have a severe impact on large numbers of people in a short period of time, often triggering public health emergencies that result in excess deaths and knock-on socio-economic impacts. Ageing populations and the rising prevalence of non-communicable diseases mean that people are increasingly vulnerable to the negative impacts of heat. Cities are not designed to minimize the accumulation and generation of urban heat, and the reduction of green spaces and unsuitable housing materials exacerbate the potential for human exposure to excessive heat. (WHO, 2024)

Changing Disease Transmission Patterns
Professor S.D. Fernando writes that global temperatures have risen significantly over the past 100 years, with an accelerating trend since the mid-1950s. Preliminary modelling suggests that rising malaria incidence will increase the transmission of mosquito-borne diseases and expand their geographic distribution, and that rising malaria incidence, in particular, is considered a potential impact of climate change. (Fernando, 2024) Climate change affects the life cycle and range of disease vectors, and the expansion of mosquito areas may lead to the emergence of diseases such as malaria and dengue fever in new areas. Malaria is already a problem at low altitudes, and warmer temperatures can alter the growth cycle of the parasite in mosquitoes, causing it to develop more rapidly and thus increase transmission, which in turn has an impact on the disease burden.

Nutritional security threatened

Future projections of global trends in maize and wheat production indicate a significant decline in yields; this decline can be attributed to the negative impacts of climate change caused by increased greenhouse gas emissions. Maize is an important part of the daily diet in many less developed countries in Africa and Central America and plays a key role in achieving food security in these regions, consuming nearly 950 million metric tons of maize annually. Wheat also plays a central role in the diet. Globally, nearly 700 million metric tons of wheat are consumed annually, and wheat alone provides more than 20 per cent of the world's calories and protein.

In order to ensure food security for a projected population of 9.6 billion by 2050, FAO predicts that food production will have to increase by at least 60 per cent to meet demand, while a 2011 report by Tilman et al. predicts that food production will have to increase by 100 per cent to meet projected food demand. With declining food production and increasing demand for food in terms of both quantity and quality, intervention is necessary. (UN, 2024)

Inadequate food may lead to a range of serious health threats in the future, including an increase in malnutrition and related diseases, growth retardation, weakened immune system function and impaired cognitive development. These problems can particularly affect children and pregnant women, reducing their resistance to disease and increasing morbidity and mortality.

Challenges

Adaptive capacity of health systems

As global climate change intensifies, the nature and distribution of health problems are also changing; for example, the spread of infectious diseases may become more widespread as a result of changing climatic conditions, while extreme climatic events, such as heatwaves and floods, pose a direct threat to human lives. Existing health systems must therefore be made more resilient, with enhanced emergency and disaster response capacity, along with improved monitoring and preventive measures for these changing trends. This includes investing in more advanced medical technologies, training medical personnel to deal with new health threats and establishing more flexible emergency response frameworks.

Environmental refugee issues
Global climate change is leading to rising sea levels, increased weather extremes and deterioration of the living environment, forcing more and more people to migrate from the most affected areas, becoming so-called "environmental refugees". This phenomenon not only increases demographic pressures on host regions, but also has the potential to trigger public health crises and increase the burden on basic sanitation. Addressing this challenge requires international cooperation and comprehensive migration policies to ensure that refugees have access to the necessary health-care services and, more broadly, to maintain social security and stability.

Allocation of funds and resources
Addressing the public health impacts of climate change requires huge amounts of funding and resources, including building and maintaining infrastructure, developing new medical treatments and vaccines, and training health professionals. However, resources are often unevenly distributed, with developing countries and poor regions in particular lacking adequate support. Equitable and effective distribution of resources on a global scale requires enhanced cooperation from the international community to ensure that all countries are able to protect the right to health of their citizens in the face of the challenges of climate change, through assistance, technology transfer and policy support.

Opportunities

Health promotion and disease prevention
The threat of climate change has prompted the public health sector to focus on health promotion and disease prevention and to raise public health awareness. Public health campaigns are used for a variety of purposes around the world and are largely based on psychological theories. These theories seek to understand the impact of the many factors in human behavior that influence decisions about health problems and their solutions. Health awareness campaigns are designed in such a way that they work to promote or protect health or prevent disease in communities or individuals by raising awareness. Health awareness campaigns are an important part of public health because through health promotion and education, the level of awareness of individuals can be raised, leading to better prevention strategies. (Bugshan, et al., 2022)

Interdisciplinary and multisectoral cooperation

The health impacts of climate change are complex and varied, involving changes in disease transmission patterns, the emergence of new health threats, and challenges to existing public health facilities. Addressing these issues requires environmental scientists to understand changes in the climate system, public health experts to assess the potential impacts of these changes on health, and social scientists to explore the impacts of these changes on social structures and behavior. Therefore, it becomes crucial to establish an interdisciplinary collaborative platform that can facilitate knowledge sharing and resource integration between different fields to develop more comprehensive and effective adaptation and mitigation strategies. Figure 18 illustrates the important role of interdisciplinary collaboration in promoting scientific research, educational innovation, socio-economic development and enhancing public participation.

Global Health Governance

As climate change is a global issue, its health impacts are not confined to a single country. This calls for a more robust and effective global health governance structure to coordinate international resources and efforts to combat the health threats posed by climate change. International cooperation can be achieved by sharing research data, coordinating health policies and implementing common defense measures. I believe that the World Health Organization (WHO) and other international organizations can take the lead in developing a global climate health strategy, assisting countries in establishing public health contingency plans to address climate change, as well as providing technical and financial support, especially to developing countries with fewer resources.

Emerging issues

Long-term public health strategy planning

Developing and implementing long-term public health strategies to address climate change requires the collaborative efforts of policymakers, scientists, and health experts to ensure the strategies are scientifically valid and practical. These strategies should include establishing robust disease surveillance and prevention systems, promoting health-enhancing activities, and developing resilient crisis response mechanisms. For example, increasing green spaces to reduce urban heat island effects, improving urban drainage systems to prevent health issues caused by flooding, and establishing rapid response teams to deal with public health emergencies. These strategies need to be regularly evaluated and updated to keep pace with the dynamic nature of climate change.

Unequal impacts

The health impacts of climate change exhibit significant disparities across different geographic locations and social groups, with poorer and marginalized communities often suffering more severely. For instance, low-income countries and communities in low-lying areas typically have less access to clean water and sanitation facilities and are more vulnerable to extreme weather events. To address these inequalities, international and regional policies must focus on enhancing the adaptability of these groups by investing in infrastructure, providing economic support, and education, ensuring that everyone has access to necessary health resources and services. This emerging 'inequality' issue will be addresses more in-depth in a next chapter.

Ongoing environmental changes

As climate conditions continue to change, new health threats emerge, requiring public health systems to be highly adaptable and proactive in responding to these changes. This means that health systems must remain vigilant not only about existing diseases and health issues but also about anticipating and preparing for potential future health risks. This includes strengthening public health education, updating medical and health facilities, and developing new vaccines and treatment methods. Additionally, transnational and inter-regional cooperation will be key in sharing information, resources, and technologies, enabling the global public health system to better respond to the challenges brought by environmental changes.

Charting a course for a resilient global health future

Following the COVID-19 global pandemic, valuable lessons have been learned regarding the imperative of strengthening outbreak preparedness and response capabilities. The future of global health therefore holds immense promise, driven by the potential for creating a robust and equitable health safety net, accelerating vaccine development and distribution, and fortifying public health systems worldwide.

The key elements that hold the greatest promise include the development of a comprehensive global health safety net, the acceleration of vaccine research and equitable distribution, and the strengthening of public health infrastructure and capabilities across nations.

The current drivers propelling the transformation of global health are multifaceted, with the urgency to reform the global public health system spurred by the lessons learned from the COVID-19 pandemic, advancements in science and technology opening new frontiers for addressing health challenges, and increased public awareness and demand for robust public health measures amplifying the momentum for change.

In the past, the progress of global health has been hindered by various challenges, including the unequal distribution of resources, inadequate investment in public health systems, and insufficient international cooperation, which will require concerted efforts by the international community to strengthen collaboration, integrate resources, and prioritize the collective well-being of all people to realize the full potential of the future of global health.

Why we should all opt for interdisciplinary cooperation.

An enhanced ability to problem solve, making it easier to address global challenges and to create adaptive learning environments.

Increased innovation in education, improving the critical thinking and creativity skills in the next generations.

Improved social and economic development, alleviating poverty more accurately.

Enhanced cultural and intellectual diversity, leading to more tolerance and understanding.

Improved scientific communication, potentially leading to an increase in public interest in science and cooperation opportunities.

Inequality: an emerging health issue

Emerging issues in the context of climate change and health are becoming increasingly complex due to the differences in geographical location and climatic conditions that lead to significant variations in the impacts of climate change. These differences are further exacerbated by disparities in economic conditions and social status, which can exacerbate health risks and vulnerabilities for certain populations.

This leads to another disruption that people in developing countries and marginalized communities are more susceptible to the threats of climate change, including emerging infectious disease epidemics and malnutrition. As a result, these communities are more likely to face health challenges that are not only more severe but also more difficult to address due to limited resources and infrastructure.

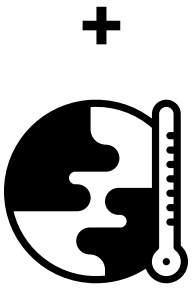
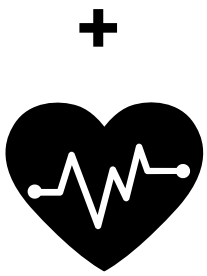
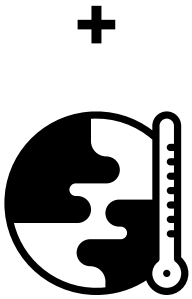
Possible future consequences of these trends include an unequal distribution of health resources, which could further widen the gap between developed and developing countries and marginalized communities. Additionally, migration and displacement are becoming more common as people seek to escape the impacts of climate change, leading to new challenges in providing healthcare and support to these populations.

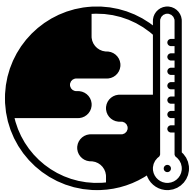
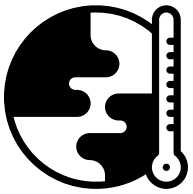
To address these challenges, long-term structural changes in society are necessary, including reinventing the public health system to better respond to the evolving health needs of communities. This may involve developing new approaches to healthcare delivery, building more resilient health systems, and investing in research and innovation to better understand the health impacts of climate change.

Enhanced global health cooperation is also critical to addressing these challenges, as climate change is a global issue that requires a coordinated response from countries around the world. By working together, countries can pool their resources, share best practices, and develop innovative solutions to address the health impacts of climate change, ultimately improving the health and well-being of people around the world.

4 scenarios of health

The different potential outcomes of global healthcare and climate change.

	While technological solutions to address climate change are increasingly available, the impacts of climate change are exacerbating health inequalities and making healthcare more expensive and inaccessible for many people around the world.	
	Significant breakthroughs are being made in the fight against climate change, with new technologies and approaches helping to reduce emissions and adapt to the impacts. At the same time, increased funding and knowledge sharing are enabling major advances in public health.	

+ 	As climate change progresses, it is contributing to the emergence of new viruses and diseases that current medical knowledge and treatments are ill-equipped to handle. However, efforts to strengthen global health governance are helping to mitigate these health risks.	 -
 -	The severe impacts of climate change are affecting people worldwide, with no one spared from the consequences. Access to quality healthcare remains limited for many.	 -

Global Governance and International Cooperation

In this second phase of this final chapter, the focus shifts to the future of global governance and international cooperation. This critical examination is essential, as the world faces the challenge of addressing the impacts of climate change, which transcend national boundaries and require coordinated global action.

The report presents four possible future scenarios, each exploring the potential trajectories of global governance in the face of a rapidly changing climate. These scenarios are designed to provide policymakers with a robust framework for understanding the complex interplay of factors that will shape the future of international cooperation.

By delving into the potential impact of different policymaking approaches and historical events, the report offers a nuanced understanding of the dynamics that can either facilitate or hinder effective global governance. This analysis serves as a crucial background briefing, equipping decision-makers with the insights necessary to navigate the uncharted waters of climate diplomacy and policy.

Reviewing the past

The Kyoto Protocol

The Kyoto Protocol, the first international treaty to set legally binding targets to reduce greenhouse gas emissions, was adopted on 11 December 1997 in Kyoto, Japan. It entered into force in 2005 and has been ratified by 192 parties. The main feature of the agreement is that it sets binding targets for industrialized countries, including the European Union. These developed countries agreed to reduce their greenhouse gas emissions to 1990 levels between 2008 and 2012. The main feature of the Kyoto Protocol is the establishment of flexible market mechanisms such as emissions trading, the Clean Development Mechanism (CMD) and Joint Implementation (JIJ). These mechanisms allow for cost-effective trading in the market. This is the basis of the EU Emissions Trading System (ETS) in which Ireland participates. (EPA, 2024)

The Paris Agreement

In response to climate change and its negative impacts, world leaders reached a breakthrough at the United Nations Climate Change Conference (COP21) in Paris on 12 December 2015 with the historic Paris Agreement. The Paris Agreement is based on a five-year cycle in which countries will take increasingly ambitious climate action. Every five years, each country is required to submit an updated National Climate Action Plan, known as a Nationally Determined Contribution (NDC). In the NDC, countries communicate what actions they will take to reduce greenhouse gas emissions in order to meet the goals of the Paris Agreement. In their NDCs, countries also communicate what actions they will take to build resilience to the impacts of rising temperatures.

In 2023, the 28th United Nations Climate Change Conference concludes the first "global stocktaking" of the world's efforts under the Paris Agreement and decides how to accelerate action in all areas by 2030, including calling on governments to take action in the next round of climate change negotiations. This includes calling on governments to accelerate the transition from fossil fuels to renewable energy sources such as wind and solar in the next round of climate commitments. In order to better plan efforts to achieve the long-term goal, the Paris Agreement invites countries to develop and submit long-term strategies. Unlike nationally owned contributions, these strategies are not mandatory. (UN, 2024)

Underlying systemic factors that contribute to the significant greenhouse gas emissions in Ireland

This research includes an in-depth examination into Ireland's agricultural sector through the lens of Causal Layered Analysis (CLA) to identify the underlying behaviors, beliefs, and systemic factors that contribute to the significant greenhouse gas (GHG) emissions from this industry.

This multidimensional approach allows us to move beyond the surface-level observations and uncover the deeper socio-structural, worldview, and mythological underpinnings that have perpetuated the environmental challenges in this sector.

At the surface level, the direct release of methane and nitrous oxide through livestock-related activities, such as enteric fermentation and manure management, is clearly identified as a primary driver of agricultural emissions. Delving deeper, the analysis reveals that Ireland's economic and agricultural policies have long been heavily reliant on the livestock sector, with an export-oriented and efficiency-seeking approach that has facilitated the expansion of the industry while failing to incentivize the adoption of low-carbon practices.

From a worldview perspective, the analysis highlights the deep-rooted traditional attitudes and sentiments of the Irish farming community towards the land, which may have inadvertently hindered the shift towards more sustainable agricultural practices.

At the deepest level, the analysis examines the myths and metaphors surrounding agriculture in Ireland, where it is seen as an integral part of the national identity and cultural heritage, reinforcing the identification with traditional practices that may not always be environmentally friendly.

This multifaceted analysis calls for a reinterpretation of the metaphor of farmers living in harmony with nature, in order to promote the acceptance and adoption of sustainable agricultural practices that can effectively address the environmental challenges posed by Ireland's agricultural sector.

Underlying systemic factors that contribute to the significant carbon emissions in China

Building on the insights from the Causal Layered Analysis of Ireland's agricultural emissions, a similar multidimensional examination of China's status as the world's largest carbon emitter reveals deeply rooted structural and perceptual factors that have perpetuated the country's environmental challenges.

At the surface level, China's large industrial capacity and huge energy demand, particularly its reliance on coal, are the direct causes of its high carbon emissions. This is closely tied to the country's rapid economic development, urbanization, and global manufacturing responsibilities as the "world's factory".

Delving deeper, China's traditional economic growth-focused development concept has long promoted resource-intensive and carbon-emitting industries. Although modern China is becoming more environmentally aware and gradually shifting towards sustainable development, the deeply rooted development model will take time to transform.

At the worldview and mythological levels, traditional cultural notions of "conquering nature" and the pursuit of modernization have contributed to the overexploitation of natural resources and environmental neglect. These deeply ingrained mindsets have shaped the current state of carbon emissions in China.

This analysis highlights the urgent need for deep reflection and structural reform at the levels of culture, social structure, and development policy in order to effectively address China's carbon emissions challenge. Overcoming the complex web of drivers will require a comprehensive and transformative approach to achieve a sustainable future.

The correlation between China and Ireland in terms of our approach to climate change

While the contexts of Ireland and China differ significantly, the analyses of their approaches to addressing climate change reveal some common underlying factors that have hindered more effective environmental policies.

Both countries' Causal Layered Analyses highlight how deep-rooted cultural attitudes, traditional development models, and vested economic interests have perpetuated carbon-intensive practices in their respective agricultural and industrial sectors. In Ireland, the strong attachment to traditional farming methods and the national identity associated with the livestock industry have made it challenging to drive a shift towards more sustainable agricultural practices. Similarly, in China, the long-standing emphasis on rapid economic growth and the dominance of resource-intensive industries have been difficult to overcome, despite growing environmental awareness.

The analyses for both countries point to the need to address entrenched mindsets, social structures, and policy frameworks that have prioritized short-term economic gains over long-term environmental sustainability. Overcoming these complex, multi-layered barriers will require comprehensive, transformative approaches that can realign cultural narratives, development strategies, and stakeholder incentives towards a more sustainable future. The experiences of Ireland and China underscore the universal challenge of reconciling economic progress with environmental protection, underscoring the importance of holistic, systemic solutions to address the global climate crisis.

Global sea level rise: inside the currents

A third analysis was conducted on the systemic factors that contribute to global sea level rise, a complex phenomenon driven by multiple factors and encompassing multiple dimensions ranging from immediate impacts to deeper cultural perceptions.

At the surface level, global sea level rise is mainly due to melting glaciers and expanding seas, which put coastal areas and small low-lying islands at risk of flooding and erosion, threatening the security of human settlements and natural ecosystems.

Socio-structural causes include the increase in global greenhouse gas emissions, in particular the significant carbon emissions contributed by industrialized and rapidly developing countries, as well as continued dependence on fossil fuels and insufficient international climate action.

The deeper worldviews reflect humanity's longstanding attitude of prioritizing economic growth over environmental protection, as well as fundamental beliefs about the domination and exploitation of nature.

At the deepest levels of culture, the myth of the "conquest of nature" and the metaphor of the "Earthship" express an awareness of the global impact of human behavior and the urgency of common action in the face of climate change.

To the roots: what is causing an international lack of technical exchange and cooperation?

The lack of international technology exchange and cooperation, particularly in the global response to climate change, is caused by multidimensional structural problems.

On the surface, there is a lack of effective platforms to facilitate technology transfer at the international level, inequality in technology sharing between developed and developing countries, and limitations in intellectual property rights and technology patent regimes that impede the diffusion of technology.

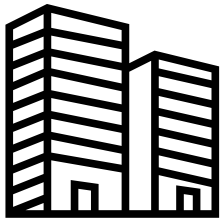
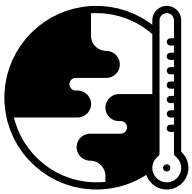
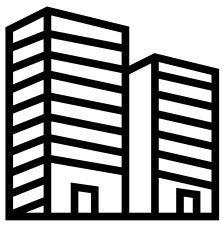
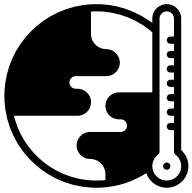
Behind this phenomenon are socio-economic-political structural factors driven by global economic competition, the prioritization of national interests, and inequalities in economic and technological capabilities between countries.

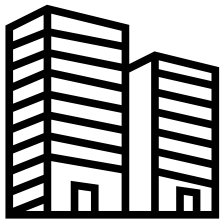
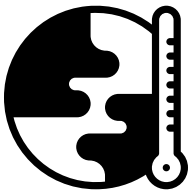
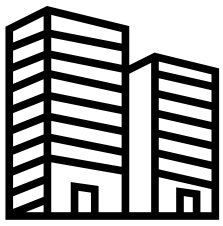
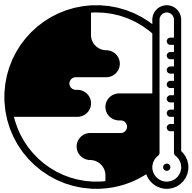
Deep-seated national worldviews, such as the emphasis on national sovereignty and the unidirectional pursuit of economic growth, also influence attitudes and behaviors towards cooperation between countries. At the cultural level, technology is seen as a symbol of national competitiveness, and there is a notion of a "zero-sum" game in which one party's technological advantage seems to have to be based on the other's disadvantage.

The interplay of these dimensions constrains effective international technological cooperation and hampers collective global efforts to address climate change. Overcoming these barriers will require a fundamental shift in mindsets, policies, and institutional frameworks to foster a more collaborative and equitable global innovation ecosystem.

Exploring diverse scenarios

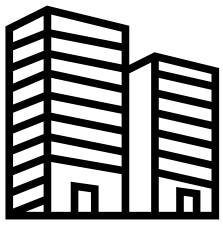
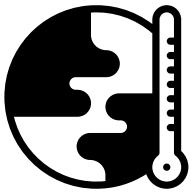
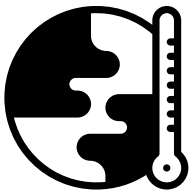
The different potential outcomes of climate change and global governance.

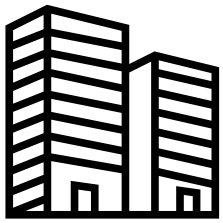
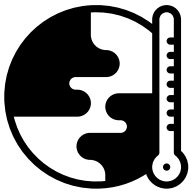
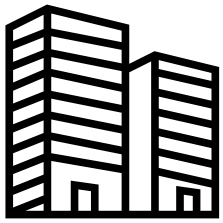
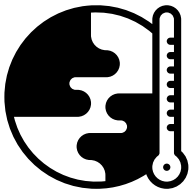
+ 	This scenario sees the best-case outcome of global governance success and effective climate crisis mitigation. In this model, climate change is successfully controlled through measures such as international cooperation, greenhouse gas emissions reductions, global action, and the implementation of a climate agreement and sustainability goals - an ideal global response.	+ 
+ 	This scenario describes a situation in which, despite the success of global governance, the climate crisis continues to intensify due to the disproportionate level of environmental degradation, the adaptation challenge, and the urgency for action. This highlights the extreme difficulty of reversing climate change, even with an effective global response and international agreements.	 -

 -	The third scenario shows a situation of failed global governance and an intensifying climate crisis, with political divisions, lack of international coordination, continued environmental degradation, and international tensions paralyzing global action - the antithesis of a collapsing global governance system.	 -
 -	The fourth scenario depicts a unique situation in which, despite the failure of global governance, the climate crisis is partially mitigated thanks to scientific and technological breakthroughs, active participation of non-governmental actions, spontaneous mitigation actions, and the widespread use of renewable energy technologies.	+ 

Exploring diverse scenarios

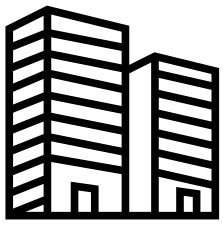
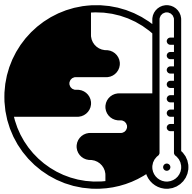
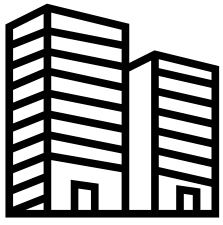
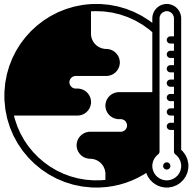
The different potential outcomes of climate change and local governance.

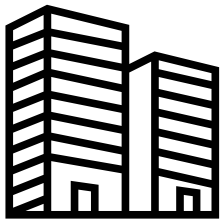
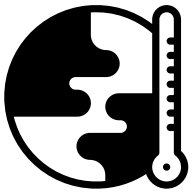
+ 	Local governments have successfully implemented climate crisis mitigation measures through innovative policies and proactive leadership, reflecting the important role of effective local governance in addressing the climate challenge.	+ 
 -	Local governments, while responding proactively with measures to mitigate the impacts of climate change, are finding it difficult to reverse the trend of the climate crisis in the short term due to the intensification of the global climate crisis as a result of these local efforts.	+ 

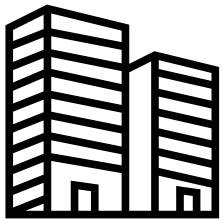
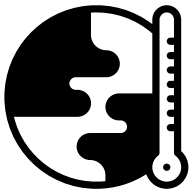
 -	The failure of local governance institutions to respond effectively to climate change and the lack of adaptation and mitigation measures result in the climate crisis continuing to worsen at the local scale.	 -
 -	The climate crisis has been mitigated to some extent locally due to national-level policies, international cooperation, or technological innovations, despite the low involvement of local governments in the climate crisis response and the lack of effective governance strategies.	+ 

Exploring diverse scenarios

The different potential outcomes of climate change and international cooperation.

+ 	The international community, through successful cooperation, takes effective climate action that leads to significant reductions in greenhouse gas emissions and mitigation of the climate crisis, reflecting the goals of sustainable development.	+ 
 -	The climate crisis continues to intensify due to historical emissions and insufficient measures, despite enhanced international cooperation, highlighting the challenges in cooperation and the slowness of action.	+ 

 -	The failure or lack of international cooperation and the absence of effective global climate policies have led to a rapidly worsening climate crisis, reflecting political divisions and paralysis in global action.	 -

 -	While international cooperation has been thwarted, some of the impacts of the climate crisis have been mitigated to a certain extent thanks to technological advances, civic action, and the independent efforts of some countries.	+ 

4 Futures of Global Governance and International Cooperation

Low carbon economy

The global economy gradually transitions from high carbon to low carbon and circular economies. The development of renewable energy also propels a global energy transformation. Countries develop feasible sustainable development plans according to their actual situations and problems. Sustainable transportation and green cities become urban development trends, alleviating the urban heat island effect. Public awareness of low-carbon environmental protection gradually increases, making low-carbon living fashionable. Political disagreements and economic competition significantly hinder international cooperation.

Developing countries face deficiencies in funds and technology, leading to their continued reliance on fossil fuels and making it difficult to transition economically. Extreme weather continues to pose threats, particularly to countries with agriculture as their primary industry. Sea levels rise continuously, reducing the land area of coastal regions and island nations, threatening the lives of coastal populations. As the population continues to grow, the shortage of food and freshwater resources becomes one of the biggest threats to human health. Developed countries have more resources, while people in impoverished areas lack basic living resources.

Unbalanced resource distribution

Environmental systems collapse, biodiversity rapidly declines, and humanity faces severe food and water crises, exacerbating the health crisis. Economic recession leads to social instability, and fragile nations and regions are prone to collapse. International cooperation disintegrates, and global governance structures are unable to effectively address the challenges posed by climate change, making it difficult for local governments to maintain normal operations under resource scarcity and social pressure. The balance of resource distribution tilts, with developed countries and regions enjoying priority access to more resources, while some areas have methods and technologies to mitigate the impacts of climate change. Energy use still relies on fossil fuels, renewable energy technology develops unevenly, and fossil fuels are gradually depleted until exhausted, plunging humanity into an energy crisis. As the population gradually increases, urban population density continues to rise. Urban development focuses on the economy, with industrial, commercial, and residential life polluting urban water systems and air. Dense living environments and polluted water and air severely threaten public health.

Collaborative efforts

As resources become scarce and biodiversity declines, the international community and local governments take measures to address food security and water resource management issues. Fairer development policies and carbon emission systems are formulated according to the actual conditions of each country. International cooperation draws on the experience of the European Union, playing a key role in resource distribution, environmental protection, and technical support, while local governments implement adaptation and mitigation strategies that fit local realities.

Multidisciplinary cooperation develops agricultural technologies and urban planning adapted to climate change, improving society’s resilience and response capacity to extreme weather events. Drawing on the experience of water-saving agriculture in Africa, freshwater resources are used more efficiently. Renewable energy is used more widely to replace fossil fuels, reducing dependence on fossil fuels and increasing energy supply. More rational urban sewage treatment and transportation systems are constructed, and people pay more attention to the sustainable development of cities.

Rise of an Ecumenopolis

AI technology continues to develop, gradually forming a continuous network of cities and societies (Ecumenopolis), with AI playing a more significant role in policy analysis and formulation. People become more dependent on AI technology, becoming more open and freer in data and technology sharing. AI technology helps plan cities and formulate more efficient water treatment systems and crisis response frameworks.

As AI is applied more deeply, public values and consumption habits also change, economic, political, and social systems undergo fundamental restructuring, including a comprehensive sustainable transformation of energy structures, food production and consumption patterns. Policies and actions at the international, national, and local levels are highly aligned, forming an effective climate action network to collectively push society towards sustainability.

Preferred future

Xiaohan's preferred future is the one with the most 'discipline'. She desires a sustainable future, which emphasizes the equal distribution of resources and sustainability. Food security and safety, efficient water management, widespread use of renewable energy, long-term human health programs and green urban development are the main goals in this envisaged future.

The future is focused on the full integration and optimization of existing resources and technologies, with a commitment to creating an environmentally friendly and resource sustainable global society. This change is not just about technological innovation, but also about a profound transformation of social structures and policy orientations.

How should it become?

Signs of future improvements will include the application of water-saving agricultural technologies, optimization of urban planning, the gradual replacement of fossil energy by renewable energy sources, and sustainable planning of cities. These changes will be directly reflected in all aspects of life, making the environment more livable and the use of resources more efficient, while also safeguarding the long-term health and well-being of human society.

What is already here?

Measures already in place, including carbon emission regimes and the application of renewable energy technologies, provide the basis for realizing this future.

A Roadmap to a 1.5°C Future

The proposed strategy for future global climate governance and crisis control envisions a positive future scenario in which international cooperation and robust policy measures effectively limit the increase in global average temperature to 1.5°C. In this optimistic outlook, the global economy transitions to a sustainable and circular model, with widespread adoption of green technologies and clean energy sources. The international community demonstrates unprecedented unity and collaboration in addressing climate change and safeguarding the environment.

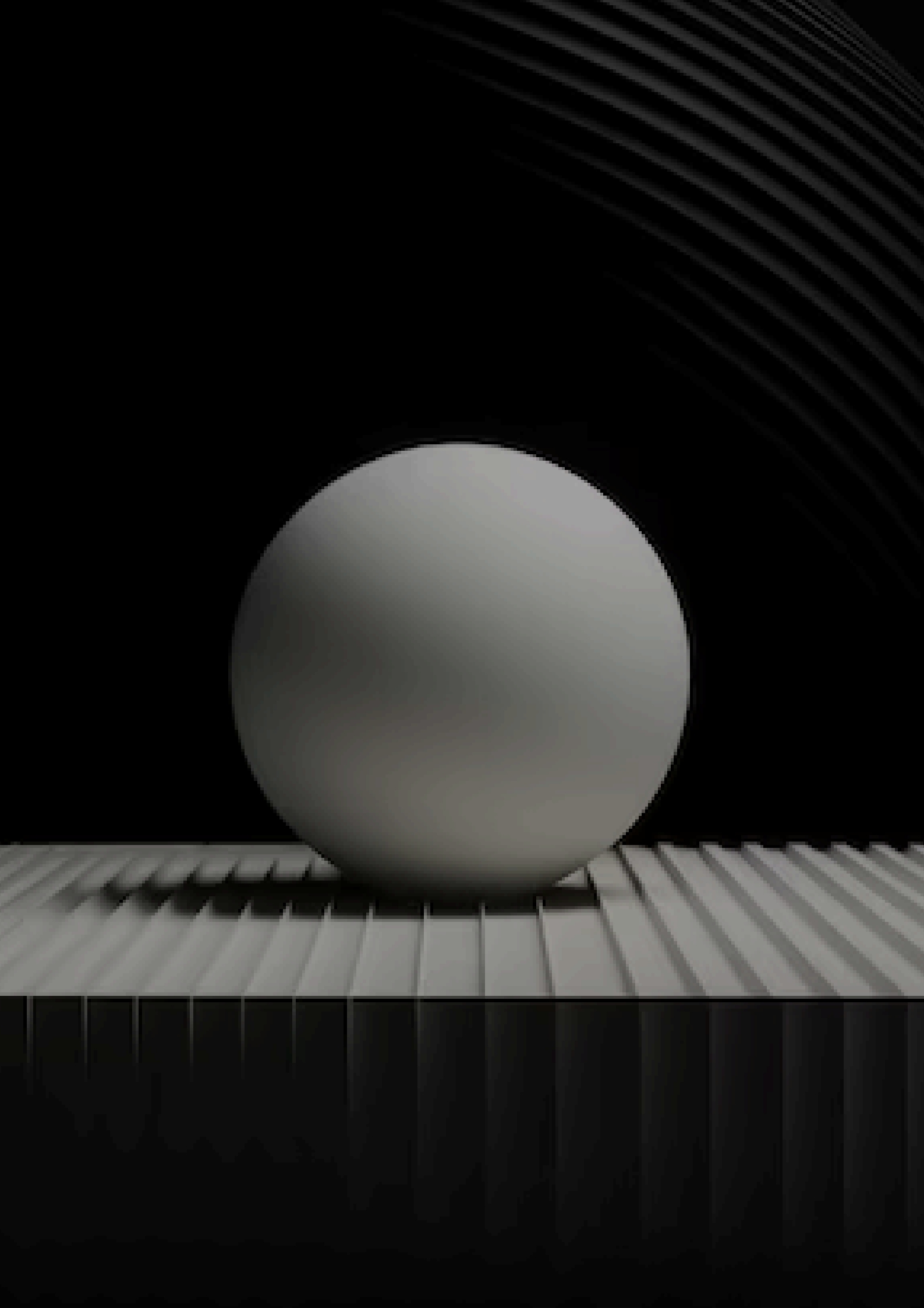
To achieve this desired future scenario, the following targets and concrete steps are proposed:

1. Starting immediately, each country will update its Nationally Determined Contributions (NDCs) every five years, committing to increasingly ambitious emissions reduction goals.
2. The next step involves the world's major economies agreeing to implement a carbon emissions trading system, providing a market-based mechanism to incentivize emissions cuts.
3. The third phase aims to complete more than 50 per cent of the global energy transition, ensuring that non-fossil energy sources become the mainstay of global energy consumption.
4. Finally, the strategy calls for the widespread adoption of low-carbon transport systems, sustainable urban planning, and the mainstreaming of green living practices worldwide.

Advice for councils

To wrap up this chapter, this part discusses the strategies and actions needed in response to global climate change, highlighting key points that require attention now and in the future.

The world is currently facing the imminent threat of climate change, and in the future its impacts will be even broader and more far-reaching, affecting economic, environmental and social well-being. Therefore, several key areas of focus are proposed: strengthening international cooperation to promote globally coherent climate action; supporting and promoting the research, development and deployment of sustainable technologies; increasing public awareness of and participation in climate change; and strengthening the role of local governments in climate action.



Thank you to all the experts who were part of the programme

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Marcel Aberle - Trend researcher - Germany
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Smart City experts

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Industry experts

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Sinead Fitness Coaching - Fitness Coach - Dublin
Ciarán Behan - Global Trade at Ernst & Young - Dublin
Joseph Grimes - Client Director at VisionR - Dublin
Jorgelina Ayub - Lead Creative Insights & Trends - Germany
Nayara Ericson - Global Cultural-Tech Research Director - Sweden

THE MAN IN THE ARENA

"It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who neither know victory nor defeat."

- Theodore Roosevelt, 1910

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