The Future of Energy - Water - Food Systems in 2050

Report from the Joint Foresight Workshop of SolarHub and ECHO Excellence Hub Projects

September 2025

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Introduction & Context

The **Excellence Hubs Joint Workshop** brought together representatives from seven Horizon Europe-funded **Excellence Hub (ExHub)** projects in **Ioannina, Greece**, on **2 July 2025**. Hosted by **SolarHub** and **ECHO**, two projects under the EC's **Excellence Hubs call**, the workshop explored **the future of energy, water, and food systems by 2050** through **co-design** and **strategic foresight** exercises. Participants scanned **trends,** identified **uncertainties**, mapped **key actors and infrastructures**, and developed **scenario pathways** for Europe's sustainability journey towards **2050**.

Connecting Innovation Ecosystems

Excellence Hubs are an **EU initiative** designed to strengthen **regional innovation ecosystems** by fostering **collaboration between academia, industry, public authorities, and civil society** — the **quadruple helix model**.

SolarHub and ECHO, the co-hosting projects, both focus on **solar energy innovation** and **energy communities**, connecting ecosystems from **Türkiye, Greece, and Portugal**, with additional expertise contributed by partners from **Germany, Spain, Belgium, and Ireland**.

What the Presentation Covers

- **Insights from collaborative foresight exercises** .
- **Key trends, drivers, and uncertainties** shaping the **energy-water-food nexus**.
- **Four alternative 2050 scenarios**, built using **Jim Dator's Futures Framework** (Growth, Discipline, Transformation, Collapse).
- **Strategic recommendations** for shaping policies, innovations, and governance frameworks.

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Workshop Facilitation, Analysis & Report

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Use of GenAI - Disclaimer

Generative AI tools were used **to support** the preparation of this material. **All analytical conclusions and scenario narratives were compiled by the author.**

- **ChatGPT** was used to **extract and analyse text** from scanned boards and workshop outputs, and to **enhance language clarity** of the finished texts.
- **Gamma** was used to **structure and format** the visual presentation.
- **Scenarios, strategic insights, and descriptions** were **authored by the workshop facilitator** based on the notes and ideas of the workshop participants.

Icons for Human Machine Collaboration are developed by Dubai Future Foundation.

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SolarHub & ECHO Projects at a Glance

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SolarHub

A Greek-Turkish Solar Energy Excellence Hub to Advance the European Green Deal

- GA: Project 101086110 — SolarHub
- Excellence Hub to connect and scale up 5 **Greek** & **Turkish Solar Energy** innovation ecosystems in a **single**, **hybrid, cross-border, interconnected Excellence Hub** dedicated to Solar Energy applications with emphasis on Agriculture/Agri-food sector.
- 21 Partners: **TR, GR,** IE, DE, BE
- 4 Years: 2023 - 2026

ECHO

Energy Communities Excellence Hubs: catalyzing energy innovation ecosystems

- GA: Project 101185725 — ECHO
- Excellence hub in **Türkiye**, **Greece**, and **Portugal** to foster innovation ecosystems, empower stakeholders, and implement sustainable, resilient and inclusive **Energy Communities (EC)** that accelerate the EU's energy transition goals.
- 24 Partners: **TR, GR, PT**, ES, IE, DE
- 4 Years: 2025 - 2028

Lessons from the past

One great example to demonstrate the difficulty of predicting the future is the 1894 Manure Crisis, when experts predicted that cities would be buried under 9 feet of horse manure in the forthcoming years.

The future was never easy to predict

1894

The Great horse manure crisis

"In 50 years, every street in London will be buried under nine feet of manure"

1923

Cars in the streets of major cities

Automotive industry eliminated one of the biggest challenges of big cities infrastructure.

The solution came from an industry that did not exist when the predictions were made (although Henry Ford had already introduced his Quadricycle in 1896). By 1923, the rise of automobiles made the whole discussion about horses obsolete.

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Lessons from the past

Examples of previous page show how the future is full of "unknown unknowns", things we don't even know we don't know.
This idea of "known knowns", "known unknowns", and "unknown unknowns" was articulated by Donald Rumsfeld in 2002.

Known Knowns and **Unknown** Unknowns

Donald H. Rumsfeld, Department of Defense News Briefing, 12 February 2002

- **Known knowns** = things we know we know.
- **Known unknowns** = we know there are things we **do not** know.
- Unknown unknowns = what we don't know we don't know.

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Lessons from the past

We live in a VUCA world

Volatile	Uncertain	Complex	Ambiguous
Public debates heat up and shift rapidly	Policy outcomes are hard to predict	Issues are interconnected	Issues have multiple interpretations
Change Accelerates	Future is unpredictable	World is interconnected	No one single way

The term VUCA was coined by the U.S. Army War College in the late 1980s to describe the post–Cold War strategic environment of volatility, uncertainty, complexity, and ambiguity.

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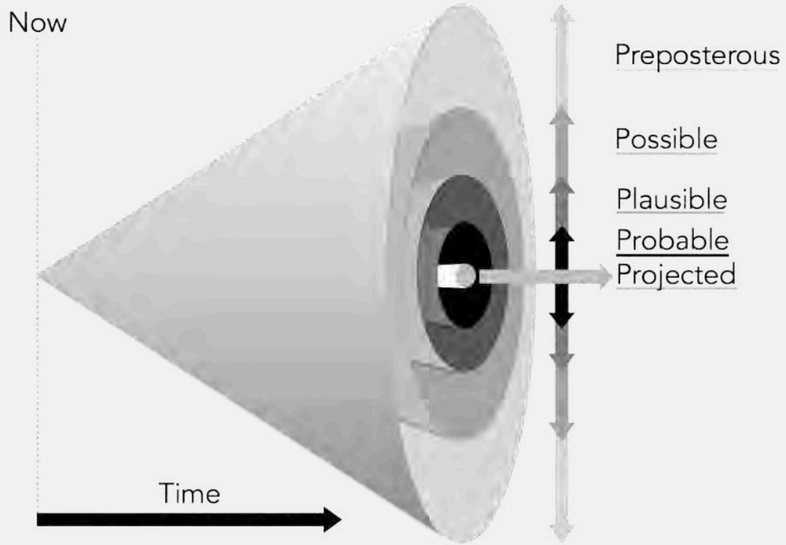
So what is Foresight?

*Foresight is looking into the future in a structured way. It's not predicting what will happen, but exploring what **might** happen so that we can make better choices today.*



- The **process** of systematically **identifying**, **exploring**, and **understanding** the future.
- A **strategic tool** helping us to make better decisions about the future.
- Foresight can help teams, companies, and organizations to:
  - **Scan** their internal and external environment
  - **Identify** emerging **trends** and **opportunities**
  - **Anticipate risks** and **challenges**
  - **Develop resilient strategies** to adapt to change

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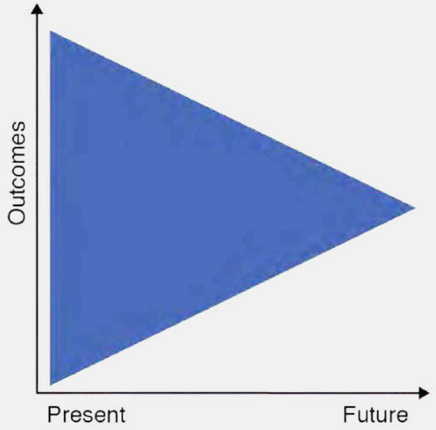
Forecast vs. Foresight

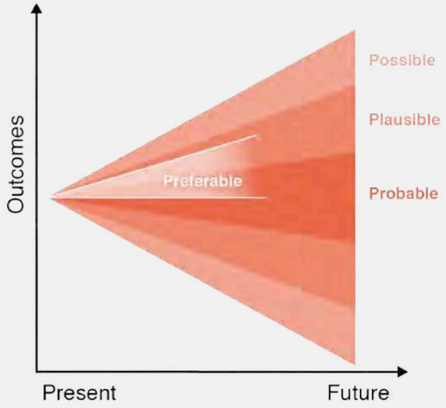


Predicting the future?

Forecasting is trying to predict what will happen in the future.

- Based on past trends and data.
- **Complex, challenging**, **never 100% accurate**.
- **Valuable** for **better decisions** in the **present**.

Case: Predict revenues of next year's sales so that we can make plans to produce enough goods or services.



Exploring multiple futures

Foresight explores possible futures and their implications.

- **Not about predicting** what will happen.
- **Understanding** what could happen.
- Helps make informed decisions and t**hink the future** in a more creative and strategic way.

Case: Explore the implications of climate change in a sector to make plans to adapt to a changing environment.

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The Focal Question

- The **key topic we are exploring.**
- It defines the environment, the time horizon, and the context.

The Future of Energy - Water - Food Systems in 2050

What futures can we imagine for our energy–water–food systems by 2050, at the local–global level, in the context of climate change, social challenges, and geopolitical instability?

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A Focal Questions is necessary to limit the scope and purpose of the foresight exercise. It is needed to define our boundaries and help participants remain focused.

Key Stakeholders Mapping

Who are the main players in our system?

Government & Policy

Public Sector

Regulate, Fund, Manage, Ensure compliance.

- EU Institutions & International Organisations *(EC, UN, EBRD, EIB, WB)*
- National & Regional Governments
- Local Authorities
- Environmental Regulators
- Distribution System Operators
- Water Management authorities

Academia & Research

Knowledge Sector

Educate, Research, Think, Invent, Skill/Re-Skill.

- Academia & Universities
- R&D Centres & Networks
- Innovation Ecosystems
- Business Accelerators, Parks, Incubators
- Foresight centres & Think Tanks
- Knowledge alliances
- Skills & re-skilling ecosystems

Industry & Market

Economic Sector

Commercialise, Supply, Transport, Distribute.

- Energy Producers, Distributors
- Investors, Banks
- Agri-food Manufacturers
- Technology developers
- Hydrogen technologies & suppliers
- Transport, logistics & waste operators

Civil Society & NGOs

Societal Sector

Advocate, Engage, Support, Scrutinise

- NGOs & Civil Society Orgs
- Energy Communities & Coops
- Citizens, Prosumers, Grassroots movements
- Social Entrepreneurs
- Consumers Associations
- Community-led governance
- Tourism actors & cultural networks

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Critical Infrastructure

What physical or knowledge-based assets are essential?

Energy Systems & Grids

Renewable energy (solar, wind, hydrogen, hydro), energy grids, smart grids, storage, and distribution.

Water Infrastructure

Water supply networks, desalination, wastewater treatment, and integrated water management systems.

Food & Agriculture

Sustainable agriculture, vertical farming, hydroponics, agri-food automation, food security frameworks.

Digital & Data Systems

Digital infrastructure, AI-driven monitoring, IoT, data platforms, early-warning systems, cybersecurity.

Circular Economy Systems

Waste management, recycling, zero-emission logistics, resource reuse, circular industrial ecosystems.

Research & Innovation Hubs

R&D centers, living labs, innovation ecosystems, and open-access knowledge-sharing platforms.

Climate Resilience Infrastructure

Flood barriers, drought mitigation systems, carbon capture facilities, green infrastructure.

Community & Social Infrastructure

Energy communities, coops, civil society hubs, citizen-led participatory spaces.

Mobility & Transport

Electric vehicles, hydrogen mobility, charging infrastructure, and integrated transport systems.

Financial & Governance Systems

Carbon markets, funding ecosystems, impact investment frameworks, and community funds.

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Critical Uncertainties

Which future developments are both important and unpredictable?

Climate & Environmental Futures

Climate change pathways, severity, and speed; extreme weather events, biodiversity loss, and desertification.

Resource Scarcity

Availability of food, water, and energy resources; competition between sectors, and access inequalities.

Geopolitical & Economic Instability

Recessions, inflation, trade wars, supply chain disruptions, carbon pricing volatility. Wars, regional conflicts, shifting alliances.

Energy Transition Pace

Speed of adopting renewables, hydrogen infrastructure readiness, and balancing fossil phase-out with demand.

Technological Disruption

Uncertainty about AI's societal impacts, IoT integration, cybersecurity risks, and breakthrough innovations.

Societal Powers

Migration flows, demographic shifts, urban-rural divides, rising inequalities, and social unrest.

Food Security Dynamics

Global food system fragility, dependence on imports, and climate-driven crop yield instability.

Water Security Risks

Droughts, over-extraction, transboundary water conflicts, and freshwater ecosystem degradation.

Policy & Governance Futures

Whether regulations will keep up with innovations, and the future of EU Green Deal, carbon taxation, and ESG mandates.

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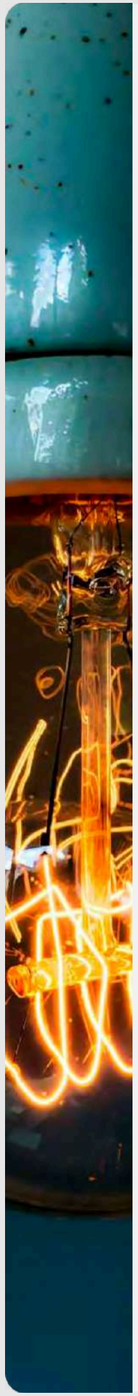
Key Events

Which key events, decisions, and developments of past 50 years have significantly influenced the energy–water–food system?



1987

Montreal Protocol — Global agreement to phase out ozone-depleting substances, setting a precedent for environmental cooperation.

1992

Rio Earth Summit (Agenda 21) — Established sustainable development as a global priority.

1997

Kyoto Protocol — First legally binding greenhouse gas reduction targets for industrialised countries.

2005

EU Emissions Trading System (EU ETS) Launch — Europe's carbon market established as a cornerstone of climate policy.

2008

Global Financial Crisis — Reshaped investment priorities, slowing renewable transitions in some regions.

2011

Fukushima Nuclear Disaster — Triggered global nuclear policy shifts and renewed focus on renewable energy.

2015

Paris Agreement (COP21) — Landmark international accord to limit global warming to below 2°C.

2019

European Green Deal — EU roadmap for climate neutrality by 2050, influencing funding and R&I priorities.

2020

COVID-19 Pandemic — Disrupted supply chains and accelerated digitalisation, reshaping resilience planning.

2022

Russia–Ukraine War — Triggered an EU energy crisis, food supply disruptions, and accelerated renewable investments.

2023

REPowerEU Plan — EU's strategic response to energy dependency, boosting clean energy deployment.

2024

EU AI Act Adoption — Introduced regulations for trustworthy AI, impacting digitalisation of energy and water systems.

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Drivers of Change: Megatrends to Weak signals

What forces are shaping change in the nexus of Energy-Water-Food? What trends affect our system today? What early signals and disruptions can we identify?

Climate Change & Environmental Impact

(-) Increased conflicts over resources, heatwaves, depletion of water, rising droughts, salinisation, reduced crop productivity, food insecurity.

Geopolitical Instability & Global Economic Shifts

(-) Rising energy and food prices, inflation, disrupted supply chains, inequality growth.

(+) Opportunities from localised energy systems.

Technological Acceleration

(-) Increased resource use, uneven digital infrastructure access.

(+) Automation, digitisation, smart grids, improved connectivity.

Urbanisation and Land Use Transformation

(-) Urban heat island effects, microclimate shifts, higher energy demand for cooling, loss of agricultural land, resources scarcity.

Demographic Shifts and Aging Population

(-) Aging population stresses social security and healthcare. Reduces economy vitality.

(+) Potential for silver economy opportunities.

Environmental Awareness & Energy Transition

(-) Backlash due to energy insecurity.

(+) Growth of clean technologies, improved recycling, sustainable production. Shift to net-zero energy, sustainable resource use.

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A deeper look into Trends & Weak Signals

- **Trend** = long-term change moving in a clearly identifiable direction.
- **Weak signal** = event or phenomenon that can be considered a first expression of change or a new trend in development.

Politics

- Disruption of Global Order (US, Russia, China, BRICS, EU).
- EU Strategic Autonomy (Energy Resilience).
- EU funding for key initiatives (Green Deal, Fit-for-55).
- International climate talks but poor commitment (e.g., Paris Agreement, carbon markets).
- Rise of Populism and Authoritarianism. Polarisation.
- Increased danger of climate migration.

Society

- Population changes (aging, migration).
- Health-driven social changes (aging, pandemics).
- Social inclusion, unity & equality vs. division, polarisation.
- Urban growth and mega-cities.
- Local initiatives and community focus.
- Public involvement in science and decision-making.
- Opportunities in an aging society (silver economy).
- Sustainable tourism and reliance on it.

Environment

- Climate change and extreme weather impacts.
- Loss of biodiversity and ecosystem collapse.
- Protecting marine ecosystems (Blue Economy)
- Water stress, desertification, and salinisation.
- Carbon capture and storage (CCUS).
- Resource scarcity (water, food, rare minerals).
- Floating solar, agrivoltaics, and hybrid farming.
- Reducing urban heat islands.
- Nature-based solutions (rewilding, restoration).

Economy

- Shifting global economic power (EU, US, China).
- Disruption of globalisation and supply chains.
- Shift to local, decentralised energy (microgrids, community)
- Circular economy (reducing waste).
- Funds for climate adaptation.
- Sustainable finance and ESG standards.
- Inflation and unstable energy prices.
- Green hydrogen market growth.
- Digital currencies and blockchain.

Technology

- AI-led changes, need for AI Governance (Ethics).
- Secure Digital infrastructure (smart grids, IoT, data models).
- Electric transport (EVs, hydrogen cars).
- Integrating renewable energy (solar, hydrogen, wind).
- Digital models for resource management.
- Biotechnology for food and water
- Breakthroughs in hydrogen, nuclear, and fusion energy
- Quantum computing and rapid advancements

The less prominent trends and weak signals appear at the bottom of every list in grey.

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Secondary & Emerging Forces

Leap in Computing & Quantum Innovations

Boosts modelling, forecasting, and real-time system optimisation.

Economic Disruptions & Recessions

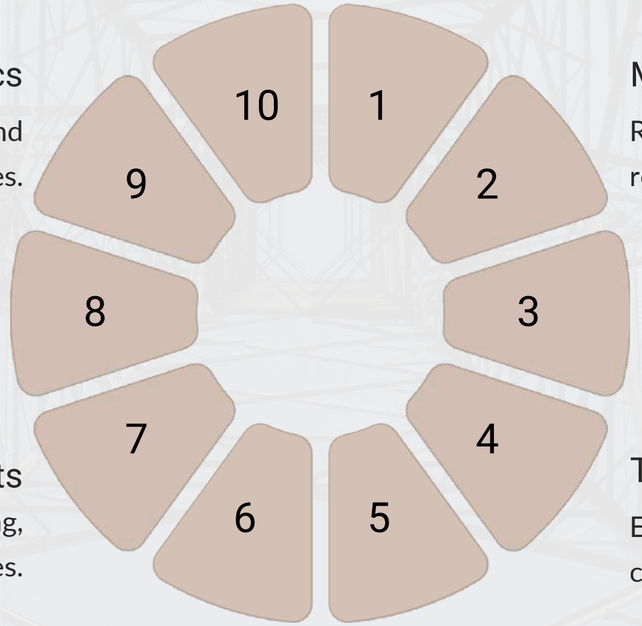
Influence affordability, investment in renewables, and societal resilience.

Health Crises & Pandemics

Redefine mobility, production systems, and preparedness strategies.

Migration Flows & Displacement

Redistributes population pressure on resources, cities, and rural infrastructures.



Political Agendas & Governance Dynamics

Influence regulatory divergence, subsidies, and coordination between regions.

Biodiversity Shifts & Loss

Affects ecosystem resilience, food systems, and natural resource regeneration.

Globalisation & Trade Realignments

Shapes resource flows, knowledge sharing, and competition for technologies.

Technological Leapfrogging

Enables rapid transition scenarios but carries adoption and equity risks.

Industrial Disruptions

Affect energy-food-water security and accelerate diversification needs.

Tourism Dynamics & Dependencies

Interconnects energy, water, and food needs in highly sensitive economies.

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Scenarios of the Future - Our world in 2050

The following 4 scenaria are descriptive narratives based on the key points and notes defined by the audience. Each team explored one of the four future scenarios: Growth, Collapse, Discipline, Transformation.

Cloud Atlas

Developed world powered by innovation experiences growth. Political Harmony Global stability achieved through historic alliances and

Black Mirror

A world consumed by unrest, lack of resources and systemic collapse. Cascading Crises Climate disasters, economic collapses and

GATTACA

A world of discipline and strong governance. Centralised Governance Strong centralised government control and strict regulations on

Interstellar

Transformative innovation reshapes society and economy. Decentralisation Governance Power shifts from centralised governments to

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Cloud Atlas

*Developed world powered by innovation experiences **growth**.*

Political Harmony

Global stability achieved through historic alliances and collaborative governance.

Energy Abundance

A fully decarbonised, 100% renewable world where energy is accessible to all.

Social Progress

Inclusiveness, equality, and wellbeing drive a prosperous, participatory global society.

After decades of crises and fragmentation, the world started to unite around the shared purpose **to restore balance between people, technology, and the planet**. A series of **UN-led summits** throughout the 2030s sparked a turning point in global politics. These negotiations culminate in the landmark **COP-50 Agreement**, where every major economy committed to achieving **carbon neutrality** by 2060. The historic breakthrough in Nuclear Fusion achieved jointly by **USA** and **China**, created a wave of **scientific** and **political cooperation**, pushing nations to join **collective governance frameworks** and work together to solve the big challenges of the future.

The **energy transition** has reshaped the global economy and today the total energy used in the planet is 90% renewable with a plan to reach 100% in the next 10 years. **Energy democracy** has allowed local communities to generate, store, and share clean power through **decentralised microgrids** and **circular economy models** minimise waste, transforming industries into fully recyclable systems. New massive **green investments** create millions of new jobs, driving innovation while ensuring **economic security for all**.

Food and water systems undergo a quiet revolution: precision agriculture, **vertical farming**, and **lab-grown proteins** deliver sustainable nutrition at scale. Integrated **water recycling and desalination systems** secure access for even the driest regions. Hunger and water scarcity, once defining challenges of the 21st century, become **solved problems**. Innovations in **carbon capture, sustainable materials, and biotechnology** accelerate restoration efforts.

The COP-50 framework sets off the largest **ecosystem restoration projects in history**, reviving biodiversity and rehabilitating degraded lands. Rising global temperatures stabilise, extreme weather events diminish, and **planetary stewardship** becomes humanity's shared responsibility. By mid-century, the developed world has embraced **abundance, collaboration, and resilience**. However, the rest of the world is still left behind and despite ambitious announcements the actual measures and support towards less developed nations is still minimal. Africa, Latin America and certain counties of Asia are still facing major challenges. The world is progressing but not equally. It seems that this is the biggest challenge of the next century.

Black Mirror

*A world consumed by unrest, lack of resources and systemic **collapse**.*

Cascading Crises

Climate disasters, economic collapses and failing governance in a downward spiral.

Fragmented Societies

Rising inequality, forced migrations, and violent unrest erode trust and cohesion.

Survival over Progress

Resource competition and institutional disintegration. A struggle for basic needs.

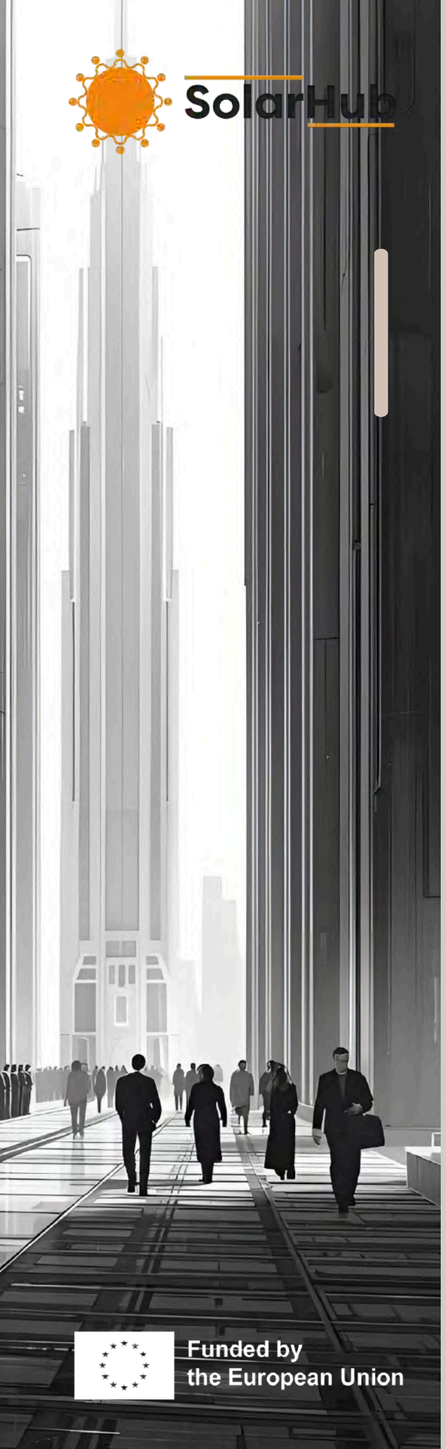
By **2050**, decades of **political inaction**, **unchecked exploitation**, and **deepening inequality** have created a perfect storm of systemic collapse. **Climate instability** ravages the planet with **terrible wildfires, catastrophic floods, prolonged droughts, and deadly heatwaves**. **Water scarcity** sparks regional conflicts, while desertification and soil infertility cripple global agriculture. Biodiversity loss accelerates unchecked, and nature itself becomes totally unstable.

Meanwhile, **geopolitical conflicts** erupt across multiple fronts. **Wars, corruption, and authoritarian regimes** dominate, while international institutions like the **UN** and **EU** fail to maintain cohesion or coordinate responses. Trust between nations dissolves, and **resource nationalism** replaces cooperation. In many regions, governments collapse entirely, giving rise to **lawless territories** controlled by militias, mega-corporations, or criminal networks.

The **global economy seems** beyond repair. **Supply chains collapse**, driving **hyperinflation** and **permanent shortages** of food, water, and energy. **Black markets flourish**, trading in survival essentials like **energy credits, clean water access, and nutrition packs**. Wealth concentrates among a handful of elites protected in gated communities, while the vast majority struggle for daily existence.

Societies disintegrate and rising **inequality and population displacement** trigger mass migrations, fuelling tensions between collapsing states and relatively stable “green zones.” These heavily protected enclaves, powered by **renewables and smart grids**, are safe havens for the privileged few, but unreachable for most. **Cyberattacks** in critical infrastructures and financial systems are daily. **AI-driven misinformation** deepens polarisation, diminishing trust in governance.

By mid-century, the **energy-water-food nexus** becomes the most precious resource and the **epicentre of conflict**. Nations hoard resources, corporations guard private reserves, and citizens fight over what remains. **Environmental tipping points** have been crossed, and without trust, solidarity, or effective governance, humanity retreats into survival mode. The world is defined by **scarcity, instability, and mistrust**. Progress has stalled and survival instincts dominate. Isolated islands of resilience exist, but for most people the future is **hard, uncertain, and fragile**.



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*A world of **discipline** and strong governance.*

Centralised Governance
Strong centralised government control and strict regulations on energy, food, and water to maintain stability.

Sustainability Above All
Climate resilience drives every policy, reshaping economies and societies under a unified vision of survival.

Society above the individual
Civil liberties are limited in favour of the common good. People accept trade-offs for security, stability, climate adaptation.

By the mid-21st century, continuous **climate disasters**, **resource scarcity**, and **geopolitical instability** push humanity to its limits. **Fires, floods, hurricanes, and rising seas** devastate ecosystems and cities, creating devastating **economic losses** even for the developed world. In the Global South, entire regions collapse under unmanageable shocks, triggering mass migrations and humanitarian crises.

Facing **civil unrest, polarised societies, and failing national leadership**, a **new global governance order emerges**. EU completed its latest enlargement that accepted every single European country and a significant constitutional change that transferred further powers to Brussels and allowed for a more flexible decision making mechanism. The **United Nations**, restructured after decades of no real power or relevance, and introduced **Supreme Security Council** of ten permanent members, including the EU, China, India, and the US, to coordinate planetary priorities. Under this new framework, **scientific councils**, **AI advisory boards**, and **civil society institutions** collaborate to **impose strict regulations** on energy use, food systems, and water resources. **Global citizenship** gains momentum as an idea, but its meaning remains unclear as to what responsibilities and rights it brings.

The transformation comes at a cost. Many governments exploit climate regulations to justify **restrictive policies**, weakening civil liberties. **China, India, and Russia** openly revoke voting rights, while even liberal democracies like the **US, Canada, Australia, and the EU** introduce unprecedented controls once considered unthinkable. Citizens, facing climate chaos and systemic scarcity, **reluctantly accept limitations** on privacy, freedom of movement, and personal consumption in exchange for survival.

Economies are **digitised, centralised, and governed by planetary sustainability metrics**. Traditional currencies vanish, replaced by a **global "Zero Carbon Equivalent"** credit system that measures every transaction against its climate impact. **Super-intelligent AI agents** are integrated everywhere and monitor flows, adjusting exchange rates and enforcing consumption quotas in real-time. Energy systems are **fully integrated** within global transition plans. Massive investments in **renewables, hydrogen, and energy storage** create powerful infrastructures, though oversight remains contested and accountability unclear. **Water security frameworks** allocate resources across borders through **binding global treaties**, while advanced **desalination and recycling systems** reduce local scarcity. **Food production** undergoes a radical transformation: vertical farms, lab-grown proteins, and **zero-waste supply chains** dominate, achieving efficiency but at the expense of traditional farming cultures.

Humanity realised that it was in the brick of collapse and took drastic measures. Unfortunately, the price for decades of inactivity and indecision, was individual freedoms. Societies are now disciplined, with optimised economies and safer stable ecosystems, but innovation is tightly controlled, diversity limited, and personal freedom diminished. The planet survived, yet the future looks more and more authoritarian sparking discontent.

Interstellar

***Transformative** innovation reshapes society and economy.*

Decentralisation Governance
Power shifts from centralised governments to networked community-driven governance and platform states.

Science Unleashed
Breakthroughs in AI, biotech, and energy create a new wave of transformative general-purpose technologies (GPTs).

Regeneration & Engagement
Economies, societies, and ecosystems evolve into actively regenerative systems, securing resilience and prosperity.

After the disruptions of the 2020s with polarisation, broken supply chains, and accelerating de-globalisation, nations struggled to enforce centralised control but failed. Civil unrests pushed national governments to relinquish more power to regional and local authorities creating new federated governance models. Governments now act more as **facilitators rather than regulators,** coordinating and negotiating rather than imposing top-down policies. Decision-making lays today with a complex network of regional and local authorities, energy communities, AI councils, and citizen assemblies. Institutions like the **EU** and **UN** still exist, they provide guiding ethical frameworks for AI, climate adaptation, and planetary resource sharing rather than direct enforcement.

The economy has shifted away from extraction and towards **regeneration**. Decentralised circular economies dominate, powered by **tokenised micro-markets** for **energy, water, and food credits**, allocated dynamically by **AI-driven pricing models**. Corporations survive only through **co-ownership partnerships** with communities, sharing infrastructures like **solar-hydrogen grids**, **biotech farms**, and **vertical food systems**. Traditional GDP metrics are irrelevant. Prosperity is now defined by an indicator factoring **resilience, well-being, and planetary health** monitored with the help of Autonomous AI Agents.

Society has become more **participatory, collaborative, and fully augmented by digitisation and AI**. Citizens act as co-producers, **generating energy, recycling water, and growing food locally**. **AI tutors** power **lifelong learning ecosystems**, preparing individuals for adaptive, fluid futures where education never stops. Ethical algorithms ensure governance remains inclusive, while breakthroughs in **biotechnology** tackle food security and health inequality, fostering greater social cohesion.

Science and technology provide the platform for this transformation. Artificial General Intelligence (AGI) has not yet been achieved but most researchers believe it is only a matter of a few years. Highly competent and advanced AI systems are everywhere. **AI-powered digital twins** simulate entire ecosystems, **lab-grown proteins, bioengineered crops, and carbon-neutral desalination** revolutionise food and water systems, and renewable-powered microgrids provide resilient, autonomous energy everywhere. Sustainability has evolved beyond mitigation into **planetary regeneration**. Climate-positive infrastructures **absorb more carbon than they emit**, and **bioengineering projects** restore biodiversity at scale.

Despite the achievements, there are significant challenges. Society is advancing fast without enforceable governance frameworks and safety regulations. The scientific breakthroughs were accelerated thanks to deregulation, however, as the world moves away from the existential threat of a climate disaster, AI is taking over more and more aspects of peoples lives with little oversight and even less governance. As many scientists warn humanity may soon face another existential threat in the form of a Super-Intelligence.

Key Recommendations

How can we address the challenges and better prepare for the future?

Decentralised Energy & Resource Systems

Community-scale microgrids (solar, hydrogen), AI-driven water recycling, and integrated local food production (vertical farming) ensure energy, water, and food sovereignty, reducing dependency on fragile global supply chains.

AI-powered Resource Management Platforms

Digital twin platforms simulate energy-water-food interactions, and predictive AI tools anticipate disasters (fires, floods, droughts), enabling real-time optimisation and climate-resilient decision-making.

Circular Economy Marketplaces

Resource-sharing platforms for communities to exchange surplus resources, alongside zero-waste supply chain hubs, accelerate waste elimination, improve resource efficiency, and build local economic resilience.

Next-Generation Education & Skills Platforms

Futures literacy hubs and AI-assisted lifelong learning ecosystems focus on sustainability, green technologies, and digital transformation, equipping citizens and policymakers with skills to adapt and co-create solutions.

Collaborative Governance & Innovation Services

Participatory foresight platforms and innovation sandboxes enable citizens, researchers, and industries to co-design policies and solutions for local challenges, strengthening social cohesion and ensuring inclusive transitions.

The slide is a consolidation of the key ideas and policy recommendations of the audience.

Annex

Methodology of the Workshop

The workshop followed a common foresight methodology. Audience was divided into groups which collaboratively explored the topic through the following steps. Teams were brainstorming and recording their ideas with the help of structured templates to facilitate discussions and keep the audience focused.

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Workshop Methodology

Map **Scan** **Imagine** **Act**

Map: Define our Environment

Define Key Actors, Infrastructures, Shaping Forces, Uncertainties & the Events that shaped our

Scan: Identify the drivers

Explore the Signals, Trends, Megatrends, Black Swans & their impact to our system. | Understand how to

Imagine: Scenarios for the

How to think about the Future with Dator's Four Futures | Who is Dator? | A pioneering futurist and

Act: Vision & Roadmap to the Future

Create Scenarios of a Future based on certain dimensions. Envision an intervention to address future

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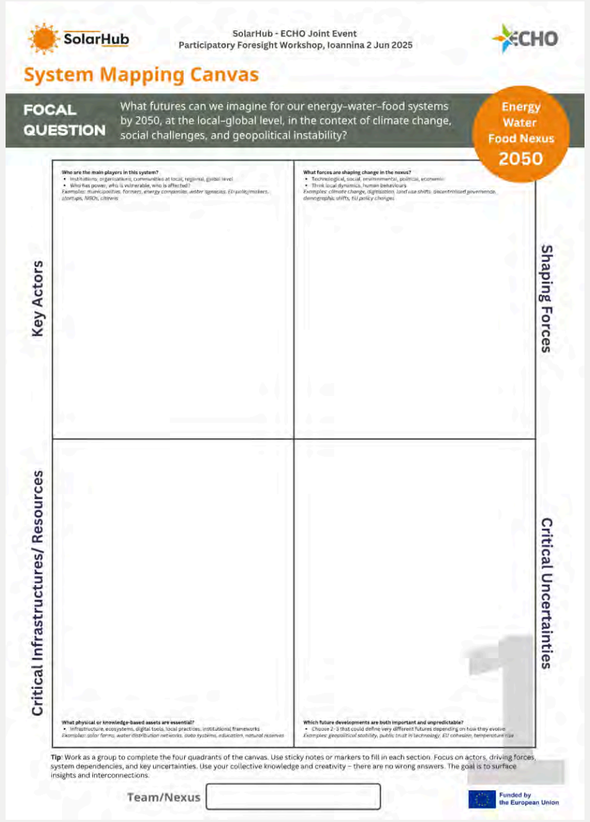
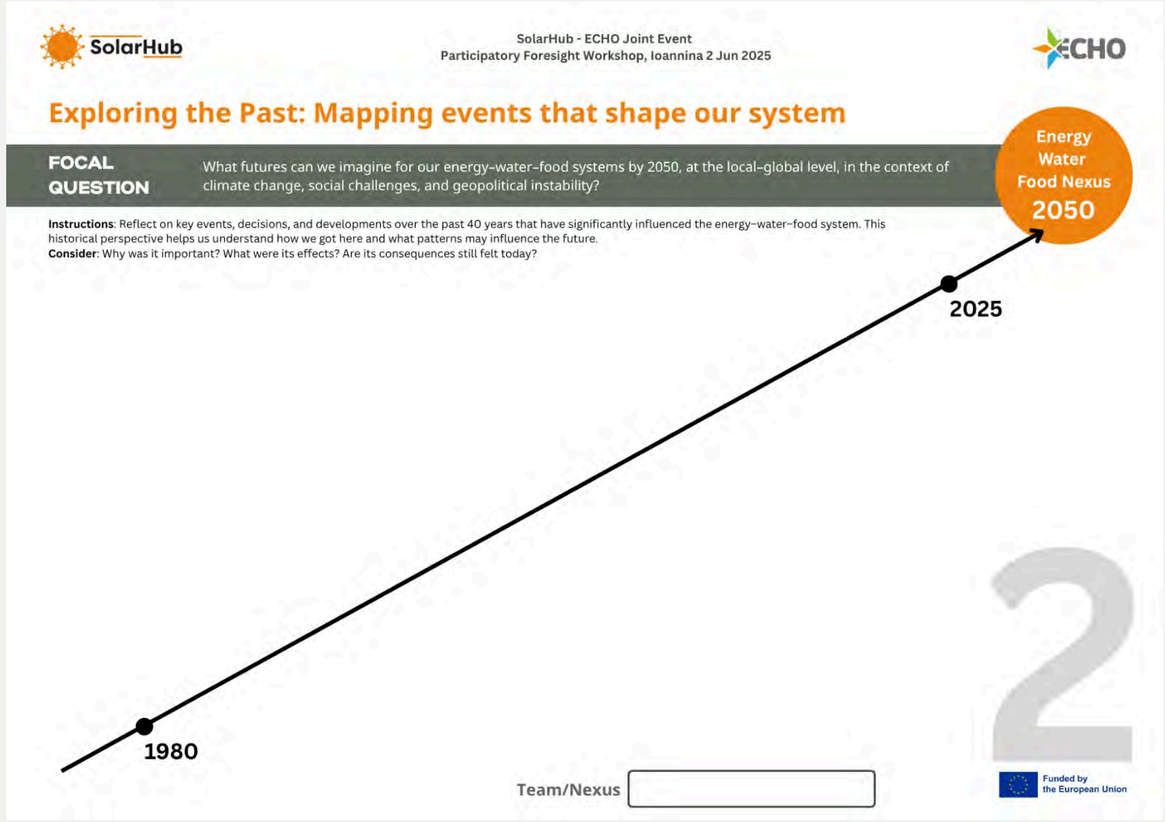
Step 1. Map: Define our Environment

Define Key Actors, Infrastructures, Shaping Forces, Uncertainties & the Events that shaped our system.





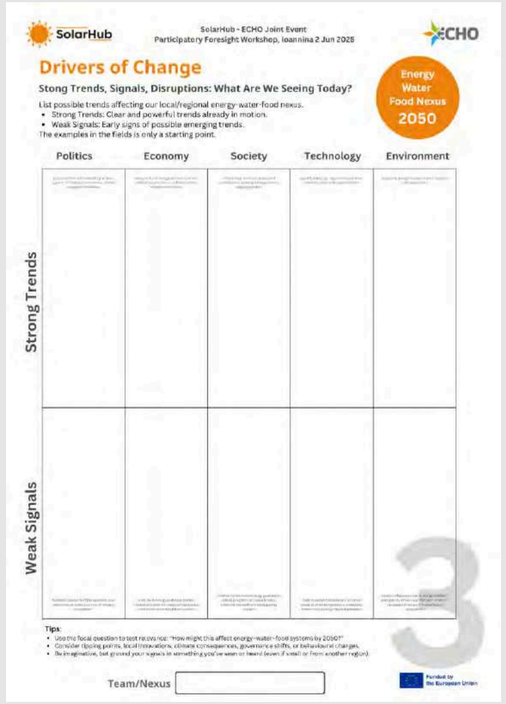
The first step in a foresight exercise is to frame the system by defining the key actors, infrastructures, and past events that shaped today's environment.

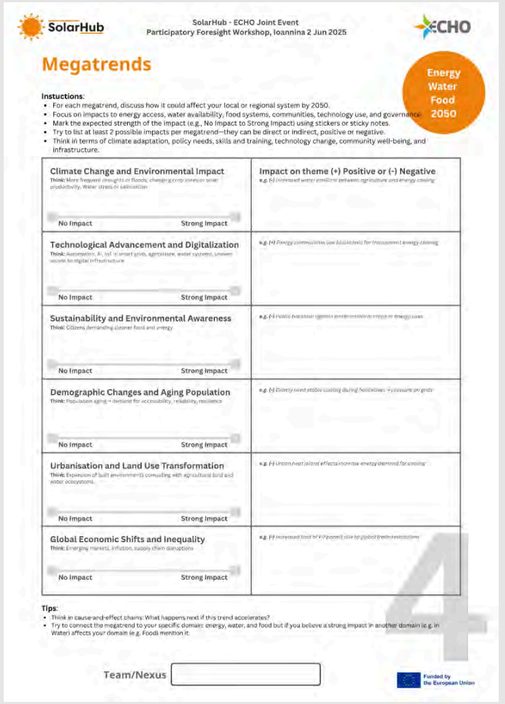
Step 2. Scan: Identify the drivers

Understanding the forces that impact our system is the 2nd step of the foresight exercise.
In this we try to identify how Megatrends and trends will impact us, see if there any weak signals that can evolve into impactful drivers and finally try to predict any black swan events.

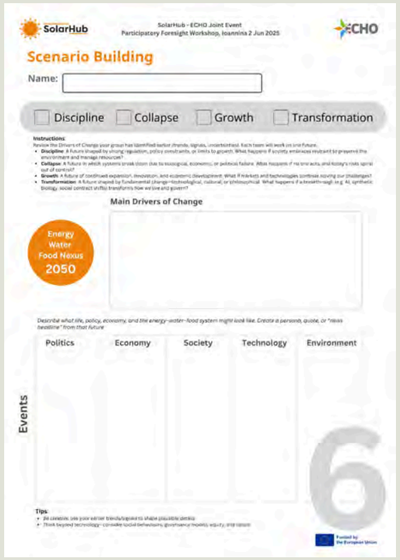
Explore the Signals, Trends, Megatrends, Black Swans & their impact to our system.

- Understand how to clarify a driver
  - **Weak signal** = event or phenomenon that can be considered a first expression of change or a new trend in development.
  - **Trend** = long-term change moving in a clearly identifiable direction.
  - **Megatrend** = a major path of development, an identifiable cluster of phenomena with a clear direction of development.
  - **Black swan** = an unexpected and unlikely factor of change that has significant effects and that suddenly pushes a chain of events onto an uncertain path.

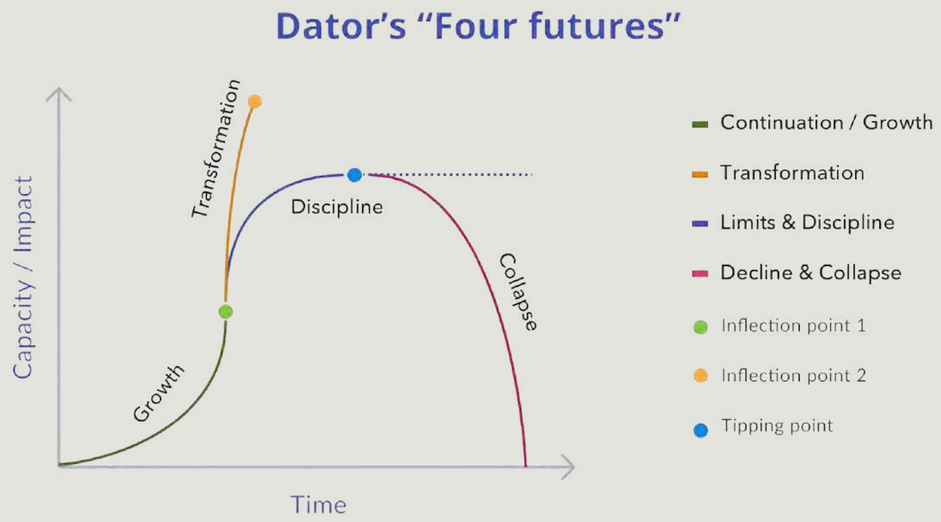




Step 3. Imagine: Scenarios for the future



How to think about the Future with Dator's Four Futures



Continued Growth

- **Business as usual.** Future continues much as today. Steady growth, technological progress, existing institutions adapting incrementally.
- *Often the "default" scenario in planning.*

Transformation

- **Radical change** from disruptive technology, social innovation, shifts in values → fundamentally new system.
- *AI, genetic engineering, post-scarcity economies, or unexpected breakthroughs.*

Discipline

- Society chooses or is forced to adopt **restraint**, prioritizing environmental limits, equity, or community needs over unchecked growth.
- *Stronger governance, regulations, or cultural shifts towards sufficiency.*

Collapse

- Systems fail—due to environmental, political, social, or economic crises—and institutions break down.
- *Resources become scarce; society fragments or regresses.*

Who is Dator?

A pioneering futurist and professor emeritus at the University of Hawaii at Mānoa, where he led the Hawaii Research Center for Futures Studies. Over several decades, Dator developed influential frameworks for futures thinking, including the **Four Generic Futures**, which has become widely used in **scenario planning and strategic foresight**. His work emphasizes participatory, values-driven approaches to exploring alternative futures in governance, technology, culture, and beyond.

His "Laws of the future":

- The Future cannot be predicted because the future does not exist.
- We shape our tools and thereafter our tools shape us.
- Any useful idea about the futures should appear to be ridiculous.

Infection & Tipping Points

- **Inflection Point 1 (green dot):** The first signal that continuation (steady growth) may not be sustainable—new challenges or pressures start to emerge.
- **Inflection Point 2 (orange dot):** A critical juncture where transformation becomes possible, driven by breakthroughs or radical shifts.
- **Tipping Point (blue dot):** A decisive moment where the system can no longer continue as before. From here, it may either stabilize under limits & discipline, decline into collapse, or pivot into transformation.

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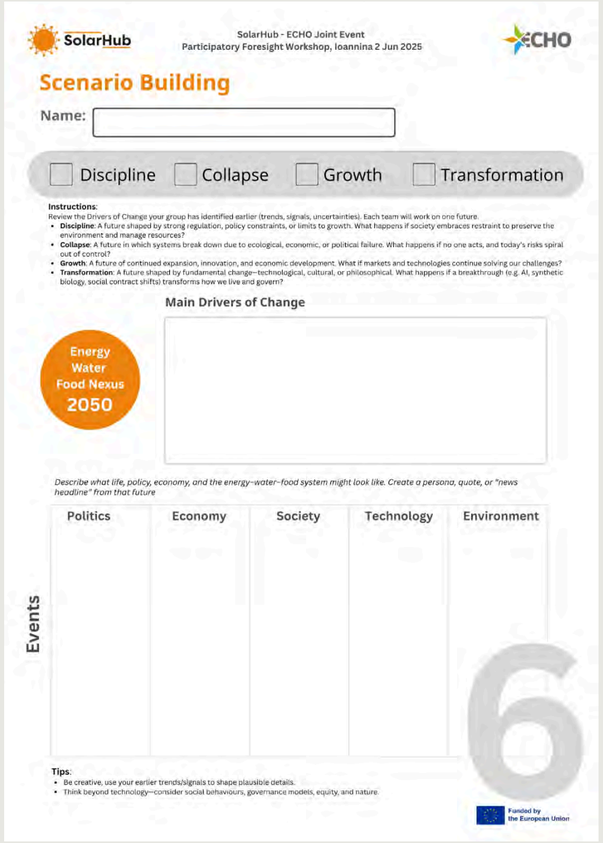
Step 4. Act: Vision & Roadmap to the Future

In scenario building (Step 6), we use the knowledge and understanding we have gained so far, on the uncertainties and driving forces, to envision plausible stories about how the system could evolve. We use the PESTE table to describe its various dimensions. These scenarios are not predictions but structured narratives that help participants explore risks, opportunities, and strategic choices.

Create Scenarios of a Future based on certain dimensions. Envision an intervention to address future challenges and risks.



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Participatory Foresight Workshop, Ioannina 2 Jun 2025

ECHO

Scenario Building

Name:

☐ Discipline ☐ Collapse ☐ Growth ☐ Transformation

Instructions:
Review the Drivers of Change your group has identified earlier (trends, signals, uncertainties). Each team will work on one future.

- **Discipline**: A future shaped by strong regulation, policy constraints, or limits to growth. What happens if society embraces restraint to preserve the environment and manage resources?
- **Collapse**: A future in which systems break down due to ecological, economic, or political failure. What happens if no one acts, and today's risks spiral out of control?
- **Growth**: A future of continued expansion, innovation, and economic development. What if markets and technologies continue solving our challenges?
- **Transformation**: A future shaped by fundamental change—technological, cultural, or philosophical. What happens if a breakthrough (e.g. AI, synthetic biology, social contract shifts) transforms how we live and govern?

Main Drivers of Change

Energy Water Food Nexus 2050

Describe what life, policy, economy, and the energy–water–food system might look like. Create a persona, quote, or "news headline" from that future

Events	Politics	Economy	Society	Technology	Environment

Tips:

- Be creative, use your earlier trends/signals to shape plausible details.
- Think beyond technology—consider social behaviours, governance models, equity, and nature.

6

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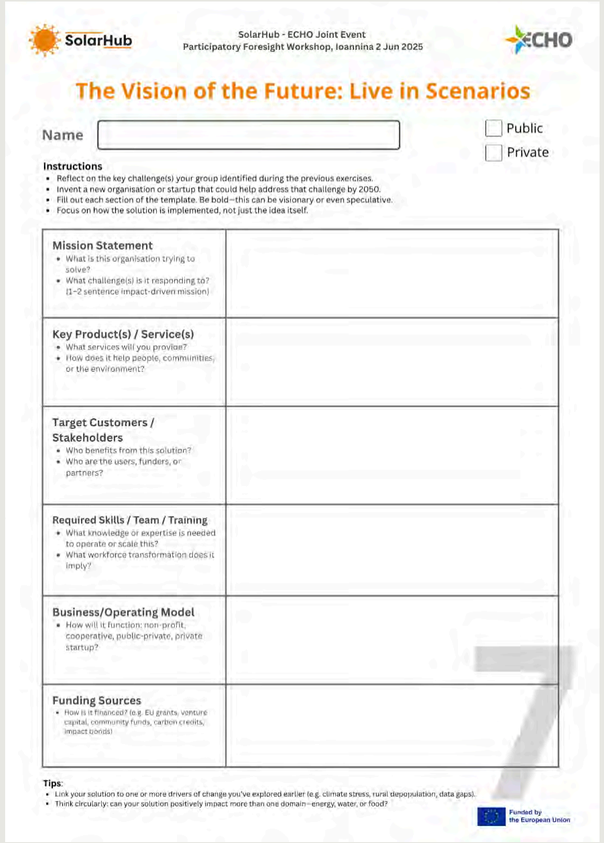

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The Vision of the Future: Live in Scenarios

Name

☐ Public
☐ Private

Instructions

- Reflect on the key challenge(s) your group identified during the previous exercises.
- Invent a new organisation or startup that could help address that challenge by 2050.
- Fill out each section of the template. Be bold—this can be visionary or even speculative.
- Focus on how the solution is implemented, not just the idea itself.

Mission Statement • What is this organisation trying to solve? • What challenge(s) is it responding to? (1–2 sentence impact-driven mission)	
Key Product(s) / Service(s) • What services will you provide? • How does it help people, communities, or the environment?	
Target Customers / Stakeholders • Who benefits from this solution? • Who are the users, funders, or partners?	
Required Skills / Team / Training • What knowledge or expertise is needed to operate or scale this? • What workforce transformation does it imply?	
Business/Operating Model • How will it function: non-profit, cooperative, public-private, private startup?	
Funding Sources • How is it financed? (e.g. EU grants, venture capital, community funds, carbon credits, impact bonds)	

Tips:

- Link your solution to one or more drivers of change you've explored earlier (e.g. climate stress, rural depopulation, data gaps).
- Think circularly: can your solution positively impact more than one domain—energy, water, or food?

7

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In visioning (Step 7), participants are called to create a vision based on a scenario. This vision responds to the challenges and attempts to mitigate the risks and dangers the scenario has identified. Insights and ideas from the whole exercise will help us build a future strategy and roadmap for the future.

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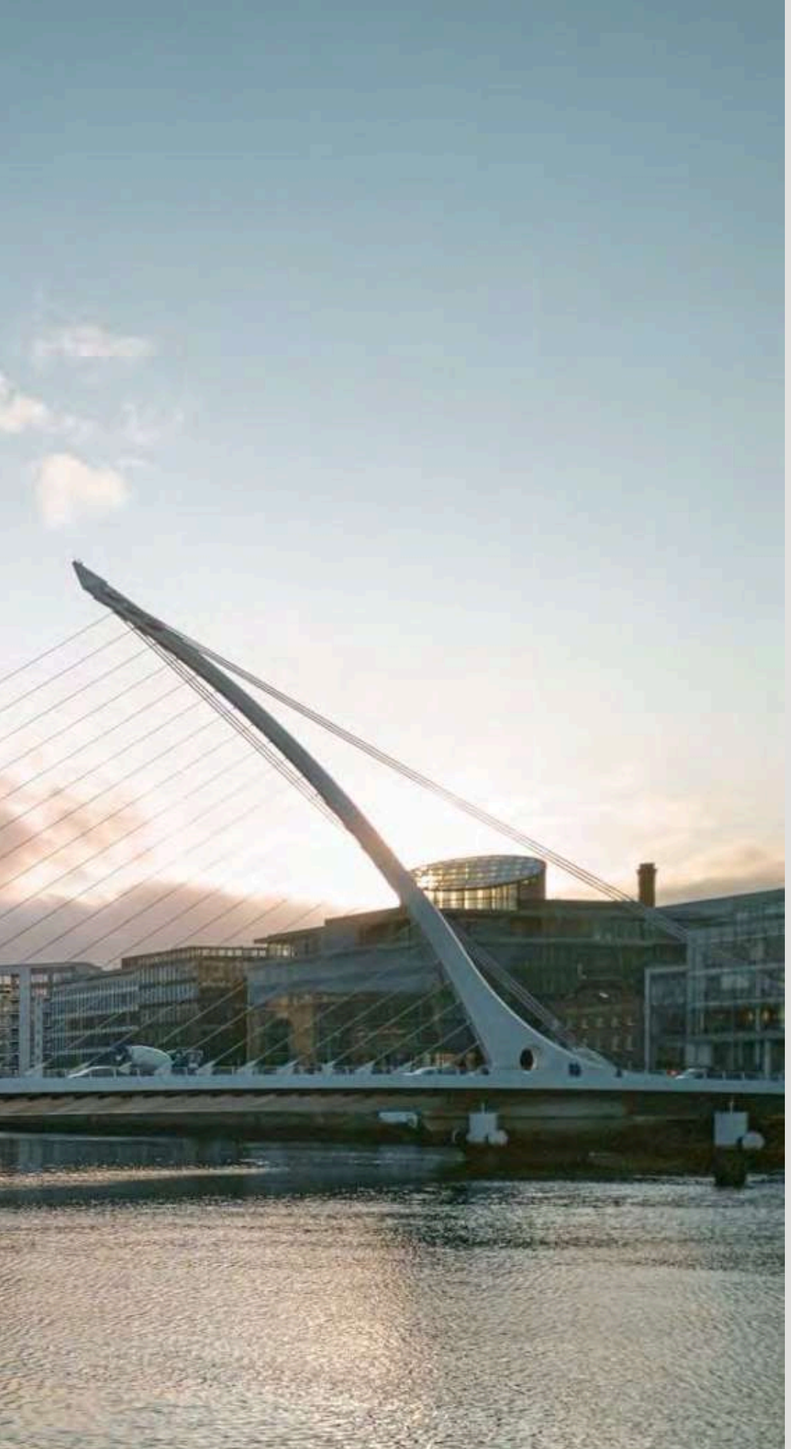

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