APENCOS

ARCHITECTURAL + ENGINEERING CONSULTANCY SERVICES

RESEARCH REVIEW

Rethinking Construction Projects in Chania, Crete.

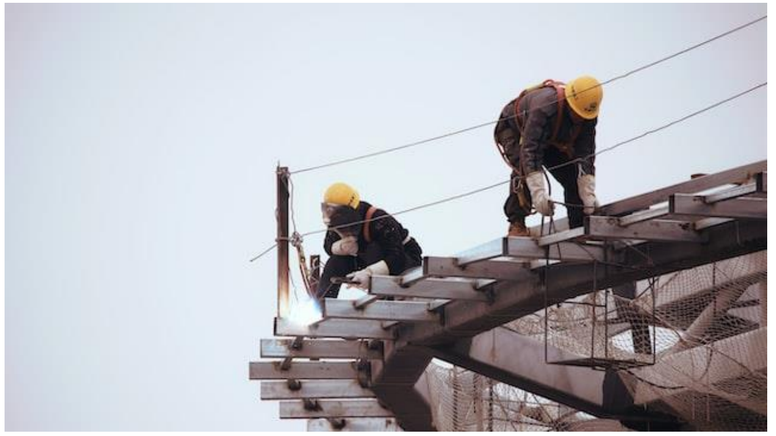
RESEARCH
DATA ANALYSIS
INSIGHTS

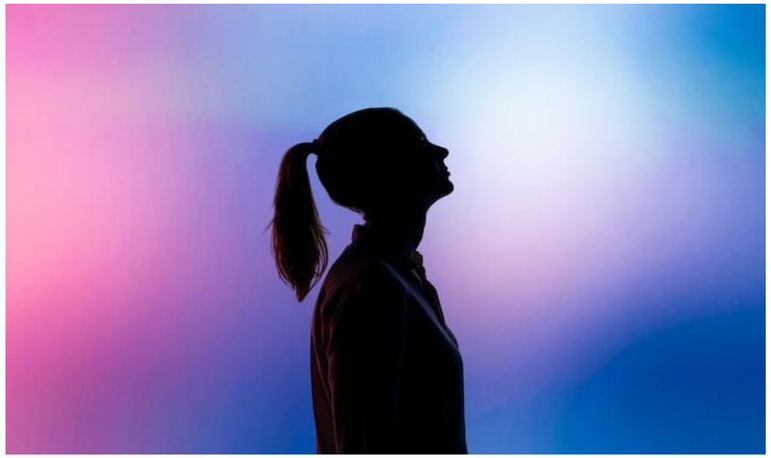
Rethinking Construction Projects in Chania, Crete

At ARENCOS we conduct independent research to assess and experiment with new approaches and practices that respond to issues our clients and their construction projects are facing.

Covid-19 and record-high energy price increases at the end of 2021 and beginning of 2022 brought to the fore the importance of systems working synergistically to support more resilient construction projects. It also showed us just how interrelated nature, property owners, technology and the built environment are.

In this issue of ARENCOS Research Review “Rethinking Construction Projects in Chania, Crete” we consider approaches to create better outcomes for property owners, developers, projects and the environment.





Circular Economy

The term circular economy refers to a relatively new construction, development and consumption model that promises sustainable growth over time. With a circular economy model, construction firms, developers and contractors alike can optimize the use of resources, reduce consumption of raw materials, and recover waste by recycling or giving it a second life as a new product.

As a waste-intensive sector, construction has the potential to greatly impact circular economy models and their successful implementation. ARENCOS promotes a ‘circular’ approach instead. Why keep on searching for new materials and resources for new construction projects when most of what you need is already up for grabs from another project?

This is the question that drives our research in this field.

Paving our way to more sustainable constructions

The Challenge

Since plenty of the material extraction processes generate unhealthy environmental impacts, the more circular economy, the lower will the carbon dioxide emissions and energy consumption be.

Based on the principles of the circular economy, ARENCOS contributes to mitigating the waste management challenges faced by the modern structures and development projects in Crete, Greece.

Findings

- Cement kilns are ideal for safely and sustainably disposing of non-recyclable waste, which can be used as an alternative to fossil fuels instead of being incinerated or landfilled.
- Whenever possible we strive to use waste minerals as alternative raw materials
- We also use construction and demolition waste as alternative aggregates.

Construction Waste: Image Source: Jonny Caspari on Unsplash

C2C Approach

Paving our way to more sustainable constructions

C2C is a novel approach towards the circular economy, which provides a framework for designing products and buildings whose resources flow safely in closed loops.

The emphasis of the Cradle to Cradle (C2C) Approach in constructions lies on maintaining inputs at their quality level to render the concept of waste obsolete.

Research finds that we are at the tipping point wherein, for the first time, human-made products have more mass than the total living biomass. Meanwhile, only 8,6% of resources are treated circularly, according to the Circle Economy's Circularity Gap Report.

The Principles to Cradle to Cradle® design

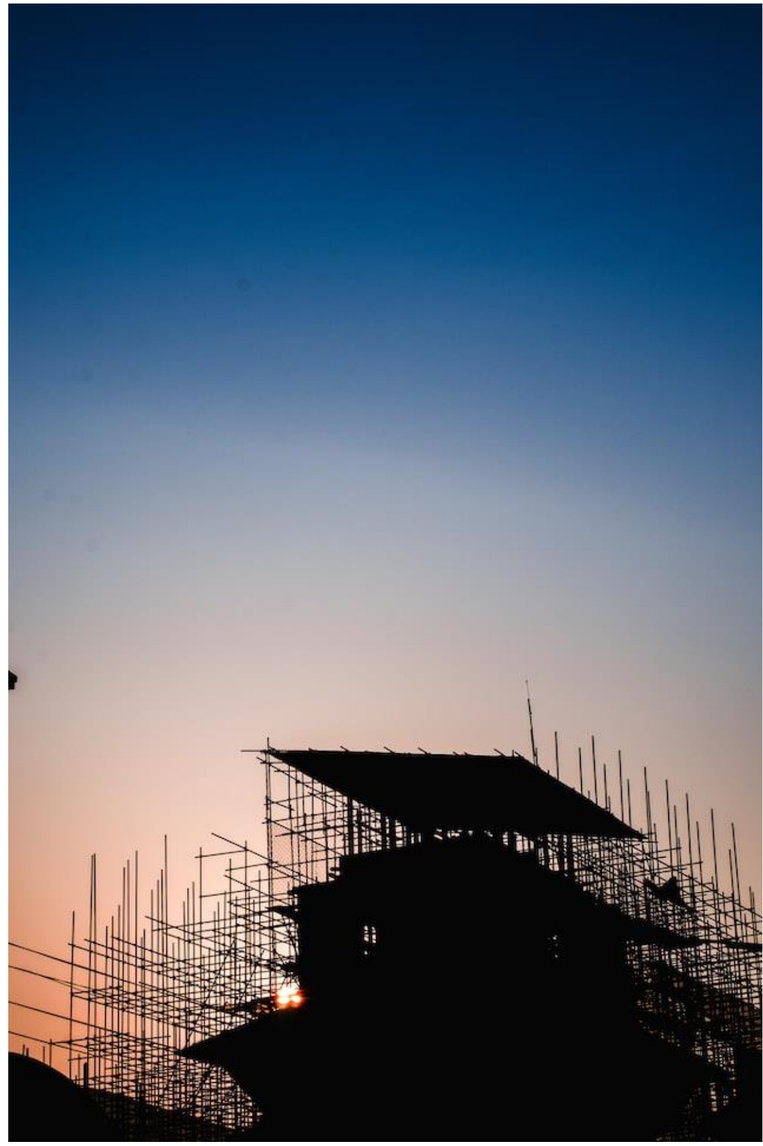
The holistic Cradle to Cradle (C2C) vision of designing buildings that produce oxygen, sequester carbon and nitrogen, and distill water like trees, may sound intimidating.

Therefore, there is an evolutionary approach that guides us in the ways to design safe, sustainable, greener and circular buildings inline with C2C's 10 Principle Criteria.

The Principle Criteria:

1. State your Intentions
2. Define Materials and Their Intended Use Pathways
3. Integrate Biological Nutrients
4. Enhance Air Quality
5. Integrate Renewable Energy
6. Actively Support Biodiversity
7. Celebrate Conceptual Diversity with Innovation
8. Add Value and Enhance Diversity with Innovation
9. Add Value and Enhance Quality for Stakeholders
10. Enhance Stakeholder Well-Being and Enjoyment

"Our team has always got an eye out for low- impact sustainable materials that could be used to replace harmful additives."



C2C Approach: Image Source: Shirish Suwal on Unsplash

C2C Approach
Paving our way to more sustainable constructions

What is the Concept of Cradle to Cradle?

Cradle to Cradle refers to the life cycle of a product or material. The traditional life cycle of a product is Cradle to Grave, a linear cycle that sees a resource extracted, product manufactured and in use before ultimately ending up as waste. C2C's core values among other include social ethics, material health, product re-usability, and water and energy conservation.

It's important to note that materials with a Cradle to Grave life cycle may be recyclable to some extent and 'live a few lives', but ultimately, the amount of recyclable content degrades over time, meaning that it is always destined to create some waste.

Cradle to Cradle, on the other hand, is what's known as a closed loop life cycle, meaning that there is no end of life for these materials in a Cradle-to-Cradle cycle — they are perpetually recyclable to some degree, though not always in the literal sense.

C2C Approach Image Source: Thayran Melo on Unsplash

Only **8,6%**
of resources are treated circularly

"A building like a tree. A city like a forest."

This quote by Michael Braungart & William McDonough, the two founders of the Cradle to Cradle® (C2C) design concept, describes its vision well.

Re-using locally excavated earth to make environmentally friendly building materials–

Paving our way to more sustainable constructions

As mentioned earlier, the construction domain is among the most carbon and material intensive sector. This construction sector is also one of the most polluting businesses globally.

For instance, excavation sites are a common source of pollution and waste of resources. More often than not, the excavated earth and mining waste end up being transported and dumped in faraway places like mines, quarries, and artificial mountains.

Inefficient activities of digging, transporting, and dumping this waste contribute to superfluous transport, air pollution, and carbon emissions. However, several firms are reusing locally excavated earth as construction materials for their commercial and/or residential construction projects.

ARENCOS is one such firm that collaborates with constructors and transporters to promote local-use of excavated earth to make environmentally friendly building materials and establish sustainability and biophilic design concepts for the entire life-cycle of a project.

At ARENCOS we are familiar with soil recycling and its transformation to eco-friendly materials like clay plasters, rammed earth, and compressed earth blocks.

Consequently, we can significantly reduce constructions CO^2 emissions, and landfilling costs and successfully raise sustainability awareness and biophilic concepts in early design.

“Another great thing about our circular economy research project is that it links up with several Sustainable Development and Biophilic Design Goals.

It’s a collaborative and challenging project, and it takes an innovative approach to reuse materials for residential and commercial constructions in Crete, Greece. And beyond recycling and CO^2 emissions reduction there is a whole range of opportunities, like water harvesting, energy saving and better thermal insulation” – Stavros

This research shows how ARENCOS is bringing sustainable change and circular economy principles to construction projects. However, creating the touchpoint between a sustainable project with a smooth integration of green specifications and at the same time, assuring comfort and functionality is not simple. To achieve far-reaching resilient outcomes, we need clear processes. This is where ARENCOS Research Insights comes in.

What does the future of circular economy in construction projects in Crete, Greece look like? Can we drive good stimulus through a holistic approach?

The road to sustainable, resilient, biophilic construction is complex and underpinned by both experimentation and a strong foundation of data, critical thinking and knowledge. Using circular economy approaches coupled with outcome-led design, we could see issues like soil acidification shift from being a weakness to a positive.

Digital Transformation

Digital Transformation (DT or DX for short) is the process of embedding innovative technologies into all aspects of business, from daily operations to strategic decision making. It involves not only a move from analog to digital instruments but also a culture shift and rethinking of ways a business should work.

Digital Transformation can assist us to address longstanding issues, identify opportunities solve issues, mitigate risks and revisit opportunities.

At ARENCOS, we are one of the few businesses in Crete, where Big Data Analytics, Artificial Intelligence and Business Digitalization are in the epicenter of everything we do; from project design to management and from risk mitigation to investment analysis.

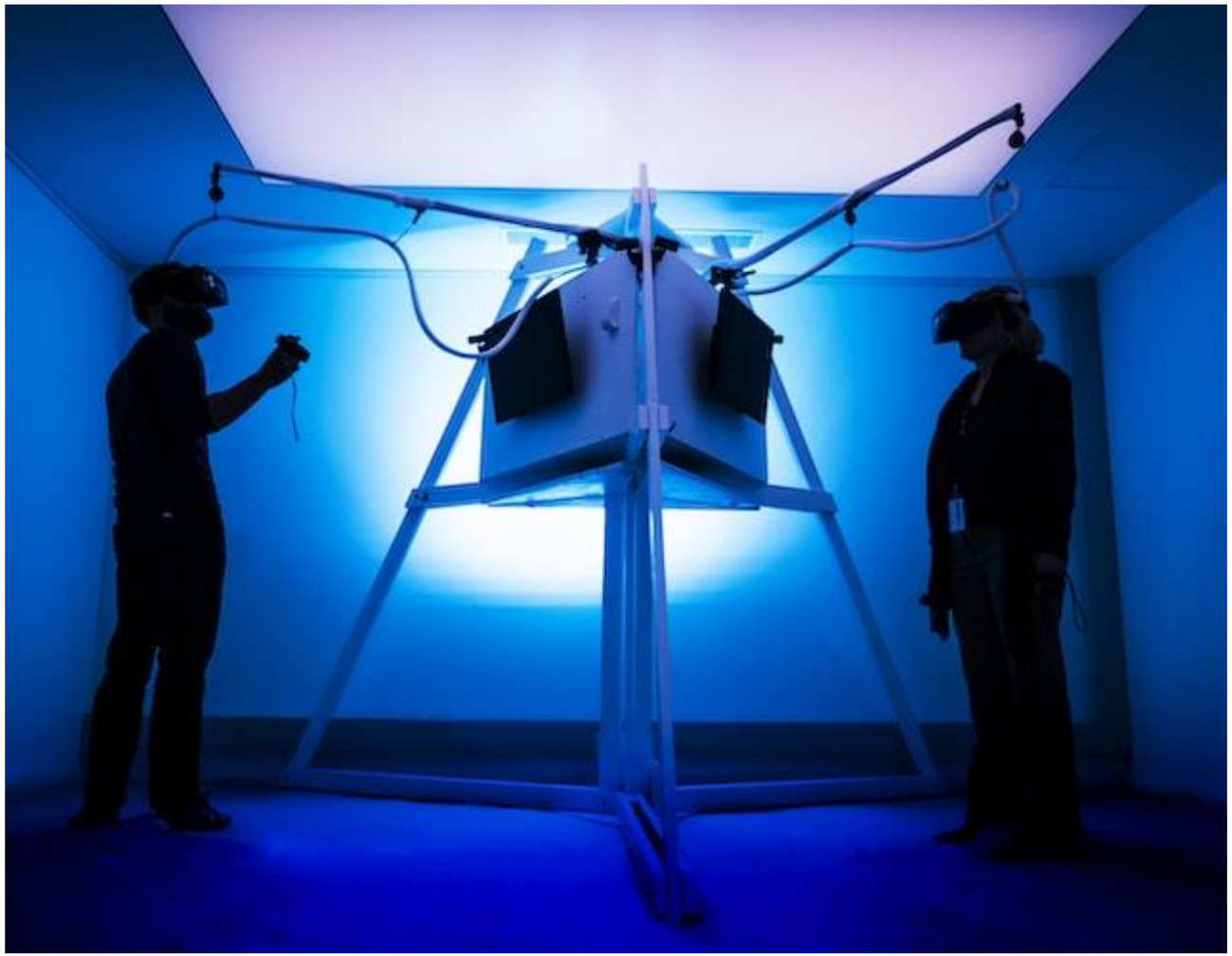
Seeing the future: designing and providing healthy, safe, comfortable and resilient buildings

The Challenge

Business Digitalization has changed our perception of functionality, planning, biophilic responsive design, sustainability, services, fire safety, building height, and scale of the building. Spatial planning in particular is getting more sophisticated, mainly due to advances in Artificial Intelligence (AI) and data analytics.

Findings

- How Data Analytics and AI tools can help us design and deliver climate responsive resilient building codes.
- Understanding the relationship between data sets, decision making,functionality and ethics.
- Why smart system architecture development requires a combination of expertise across digital technologies, design, construction planning, and management.



Digital Transformation Image Source: Stella Jacob on Unsplash

ARENCOS

Seeing the future: designing and providing healthy, safe, comfortable and resilient buildings

As construction projects grow in complexity and size, we are constantly facing new challenges. New technologies and tools promise better and faster solutions, but it's vital to be confident that the tools and answers are up to the task, especially when operations, and the work environment have such high priority as a matter of course.

Our Passive House Design modelling software is already assisting property owners and developers to understand at the very initial phase of the design, the importance of Passive House Principles to effectively manage moisture, thermal transfer, air, and sunlight for exceptionally comfortable, healthy, and super-efficient future-proof buildings.

By integrating the advantages of geospatial and data analytics with AI and visual computing, our planners can get a better sense of future needs for the building and its associated infrastructure, so they can then optimally allocate resources over different time period and establish flexibility into design.

However, to ensure the quality of any output simulations, you need quality input. The data has to be reliable enough, accurate and relevant.

Before concentrating on any design intervention, an understanding of how people use the space in the real world is required. One of the biggest challenges we faced in the past was the availability of such data. On May 2022 we launched Datanalytika, a state-of-the-art platform where Big Data play the most significant role. We put purpose at the core of our strategy.

Our purpose-driven approach facilitates growth, it allows businesses and individuals to broaden their mission, create a holistic value proposition, and deliver lifetime benefits.

datanalytika

ENRICHING DECISION MAKING

From Chania historical property prices to construction activity data. Harness the power of Big Data and AI to build confidence in your decision making. Datanalytika assists clients replace information with reliable data for the real estate and construction activity in Crete, Greece and turn information into insight.

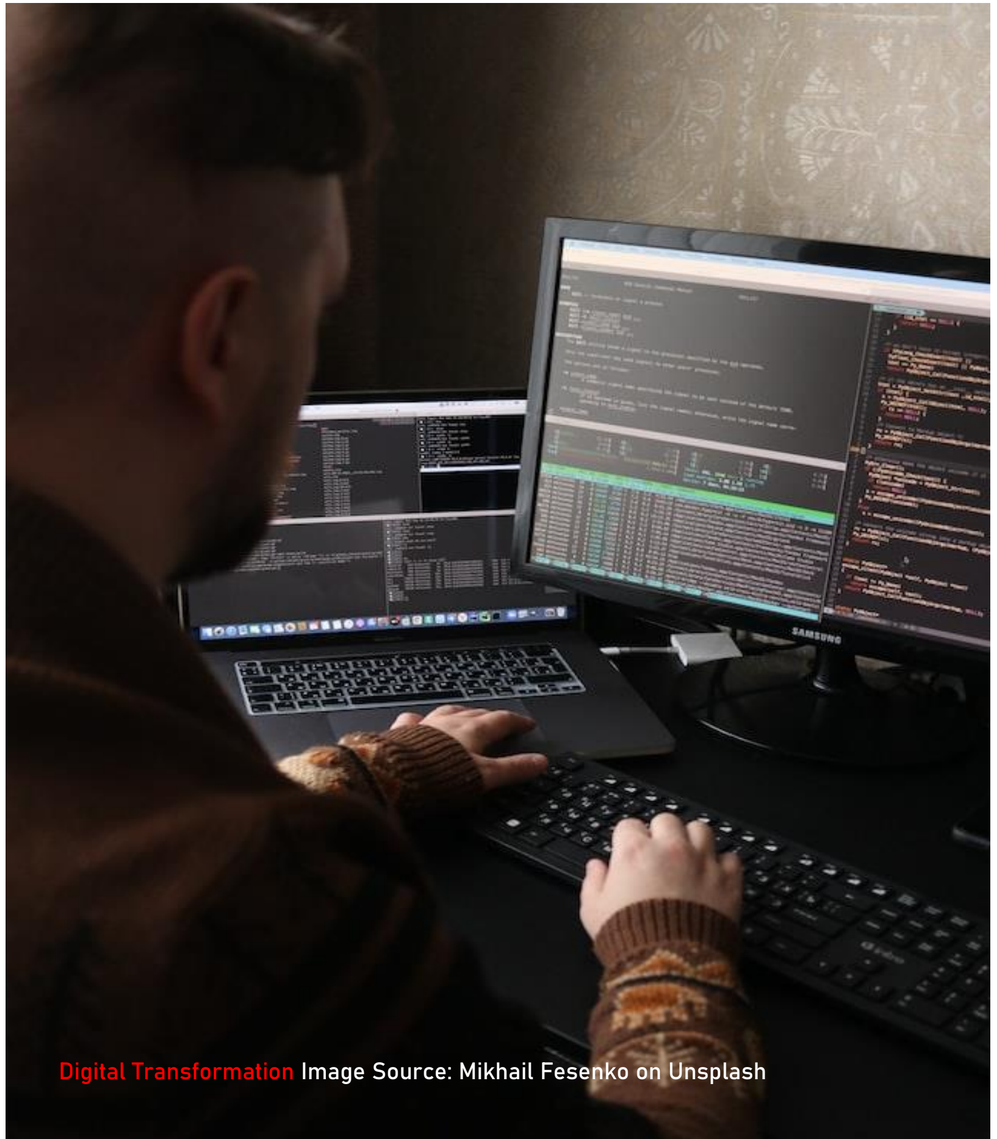
Seeing the future: designing and providing healthy, safe, comfortable and resilient buildings

Collecting, analyzing and maintaining data is crucially important for the performance and business continuity of any business including those involved in the construction sector. However, in Greece, the distribution volume of both construction data and historical prices data for materials and equipment is moderately small while no data for further research are available in Chania, Crete.

One of ARENCOS strengths is to be creative thinkers with an attitude to share the values generated, allowing us to advise our clients bias-free on their best way forward," says Stavros Thomas, Senior Consultant in the Advanced Digital Engineering team. "We wanted to better understand the options for our clients to close the loop between modeling and real-life data.

One aspect we've been looking at is the difference between creating a generic biophilic design framework for residential projects versus a dedicated list of priorities for an energy efficient and sustainable structure."

However, there are many challenges to look at: Firstly, modeling tools require good data sets to operate and generate accurate results, which means that data collection must guarantee appropriate quality, quantity, and diversity. Then, we need to know how to manage changes, risks and material shortages and apply these parameters to the modeling process. It's important to know and understand all these elements before deciding which approach to take.



Digital Transformation Image Source: Mikhail Fesenko on Unsplash

Resilience

We have chosen the word “resilience” as a term that includes the design, planning and construction development strategies needed in order to meet the challenges of the future construction projects. Resilient design is, in a lot of ways, an expansion of the definition of sustainable design.

However, for civil engineers, architects and designers, it is another layer in the design process. For property owners, it’s an additional cost, but at the same time, it is a necessary investment for their properties to adapt and respond to changing conditions while maintaining functionality.

It seems true that many of the strategies needed to accomplish resilience–such as really well-insulated homes that will keep their occupants safe if there is no power or if interruptions in heating occur–are exactly the same strategies we have been assessing and promoting for years in the green building design. The solutions are mainly the same, but the motivation is one of life-safety, rather than simply doing the right thing.

Resilience Image Source: Ümit Yıldırım on Unsplash

ARENCOS

Resilience: how it applies to buildings, and what designers and builders need to know about the future of resiliency planning.

The Challenge

In spite of the term's fuzziness the urgency to construct residential and commercial projects resiliently continues to grow. As most scientists agree that violent weather events will become more frequent and problems or bottleneck phenomena in the supply chain will increase, code officials, governmental authorities and regulatory agencies respond with a slew of new terms, codes and regulations while people insist on re-building in the same places as if nothing had ever happened.

Findings

- Low carbon input materials, such as wood and low-energy input masonry can be exceptional solutions for resiliency planning.
- Achieving narrower floor plates and internal courtyards for maximum daylight.
- Flexible, multi-use buildings.
- Use of local materials to mitigate development costs, increase durability and facilitate resilience.

Resilience Image Source: Lasse Møller on Unsplash

The future is resilient but resilient design must be collaborative, cross-disciplinary, and community-focused

Buildings in any geographic location are subject to a wide variety of natural phenomena such as windstorms, floods, earthquakes, and other hazards. While the occurrence of these incidents cannot be precisely predicted, their impacts are well understood and can be managed effectively through a comprehensive program of hazard mitigation planning.

Ongoing changes in climate patterns around the world may alter the behavior of hydrometeorological phenomena within our lifetimes. The frequency and severity of floods, storms, droughts, and other weather-related disasters is expected to increase, as is the risk from associated changes in the manifestation of other hazards such as wildland fires.

USA National Institute of Building Sciences

Resilience Image Source: Claudio Schwarz on Unsplash

ARENCOS

Bending our assets: reconsidering construction projects flexibility for better resilience

When discussing building resilience with a client, we pursue to form a holistic understanding of risks and uncertainties before considering mitigation strategies. Not all locations in Crete or building occupancy types have the same threats, and the threat picture -if any is evolving constantly.

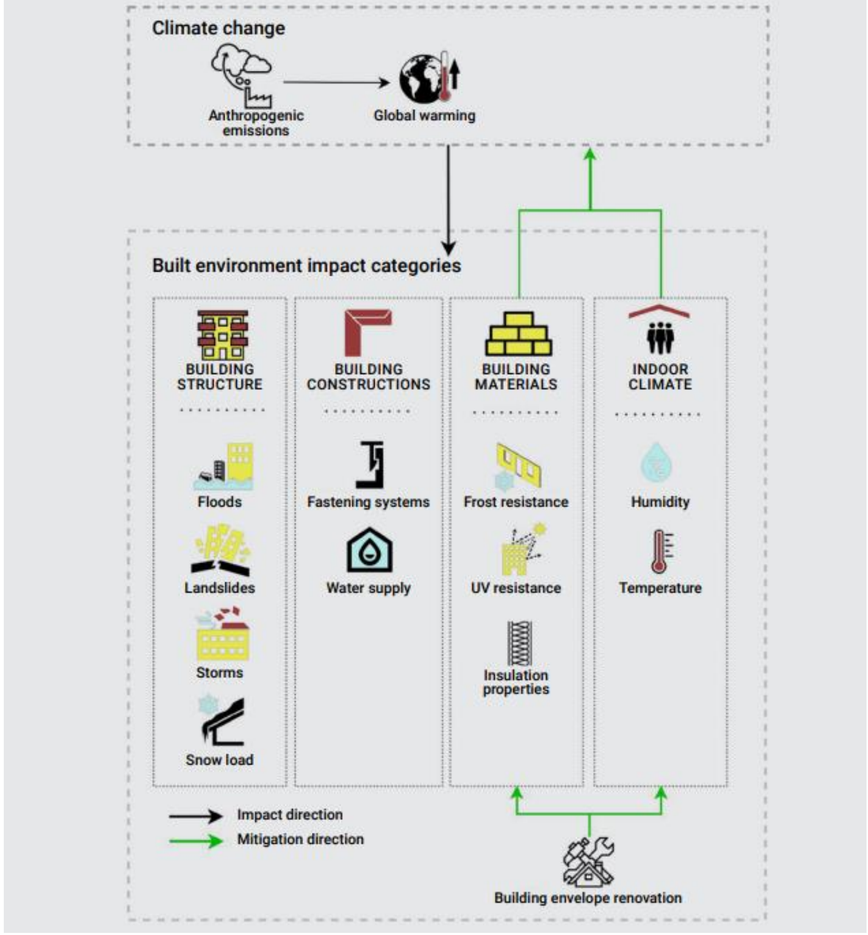
Climate change, technology progression and geopolitical events have brought a wide range of threats closer and made traditional understandings of 20–50-year events questionable. Clients in hot zones for floods, wildfires and extreme winds, for example, need to pay special attention to new climate science data. Clients in cities need to give greater weight to safety, comfort and risk management flexibility.

As engineers, researchers and designers, we take these and other parameters into consideration in conducting a resilience level assessment for the proposed project.

For existing buildings, we also conduct a detailed property inspection survey to document vulnerabilities, issues and spaces for improvements. From these analyses we create a benchmark table, which integrates the results of all our analyses and surveys into the project to facilitate decision making and accelerate the development process.

Our role as designers, architects, engineers and consultants is to lead building owners and developers through constructive discussions and embrace a more resilient concept of continuity.

Climate change impacts on buildings



Net Zero

Residential and commercial buildings in Crete, are increasingly expected to encounter higher and more complex design and performance requirements: they should be sustainable; energy-autonomous, use zero-net energy; establish wellbeing, foster a healthy and comfortable environment for the inhabitants; be smart, yet economical to build, operate and maintain.

A zero emission building is defined as a building with a very high energy performance, with the very low amount of energy still required fully covered by energy from renewable sources and without on-site carbon emissions from fossil fuels.

Net-Zero Image Source: Claudio Schwarz on Unsplash

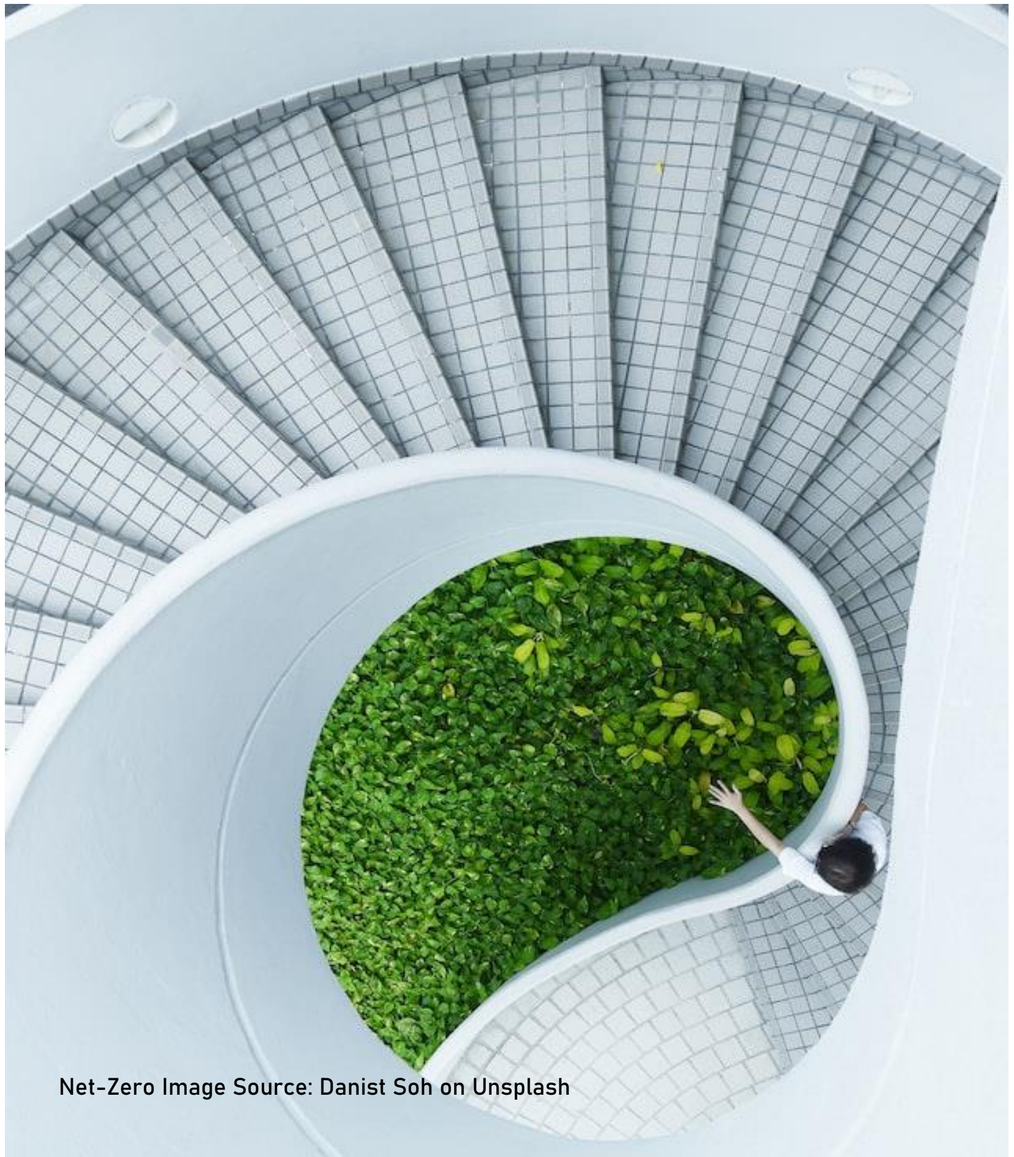
Net-zero properties: developing energy efficient and high-performance buildings in Crete, Greece

The Challenge

Construction is directly or indirectly responsible for almost 40 percent of global CO_2 emissions from fuel combustion and 25 percent of GHG emissions as a whole. These figures include materials such as cement and steel. Within buildings, heating and cooking currently produces 6.0 percent of global emissions by forecasting emission costs up-front we can make better early design decisions.

Findings

- A carbon lifecycle assessment tool for construction materials can inform early design choices to reduce the carbon footprint of our buildings.
- Digital tools can correlate the embodied energy of a building with demographic lifecycle occupancy patterns, assisting the creation of generic but flexible high-rise residential design.
- We can accelerate circular economies by enabling location-specific, nimble responses toward material use, enabling a more resilient built environment.



Net-Zero Image Source: Danist Soh on Unsplash

ARENCOS

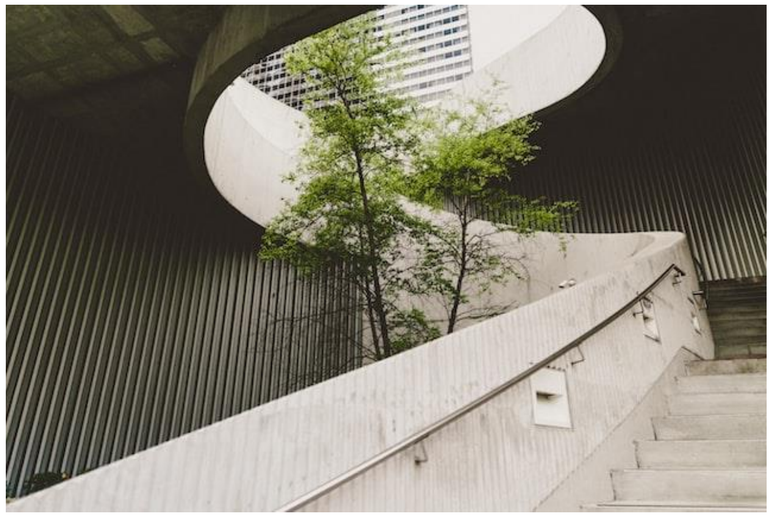
People, structures and technology: Our net zero building design vision.

Energy consumed in residential and commercial buildings accounts for more than 45% of the energy used worldwide, and it has become a widely accepted fact that new technologies, practices, methods, and tools in the building modus operandi can establish and foster substantial savings in energy and mitigate the associated carbon footprint.

Moreover, modern buildings nowadays are increasingly expected to meet higher and potentially more complex levels of performance and maintenance.

They should be sustainable; energy-autonomous, use zero-net energy; establish wellbeing, foster a healthy and comfortable environment for the inhabitants; be smart, yet economical to build, operate, and maintain.

Zero-energy or even passive-energy buildings are becoming a high priority for design firs and property owners. A NZEB/PEB refers to a construction with a zero or negative net energy consumption over a typical year.



Net-Zero Image Source: Alexander Abero on Unsplash

This amphidromic flow should result in a net-positive or zero export of power from the building to the electricity grid. The NZEB/PEB design concept is a progression from passive sustainable design. Various innovative energy-efficient technologies are mature and can be considered for the improvement of energy efficiency and indoor comfort improvement in buildings: Improvement of the building fabric, i.e. improvement of insulation, an increase of thermal mass, cools materials, phase change materials, etc.”

ARENCOS

Net-zero buildings in Crete: developing structures and spaces that matter

At ARENCOS we strive to contribute to the creation of a net-zero assessment toolkit to help the construction sector in Crete, Greece achieve excellence in the transition to a resilient design approach.

The first part of the toolkit is a database with construction materials and equipment produced in Crete.
The tool generates a schematic building by taken into account the local produced materials. The user then selects a material and specifies a construction method and the resources for the various building elements (i.e. a concrete beam, a steel frame, a glass window).

Next, the tool calculates the lifecycle carbon footprint and energy demand of the building which, when multiplied, reflects the real performance of the entire structure.

Numerous innovative energy-efficient and AI technologies are currently available and mature enough to be considered necessary elements to improve the energy efficiency of buildings and optimize indoor well-being:

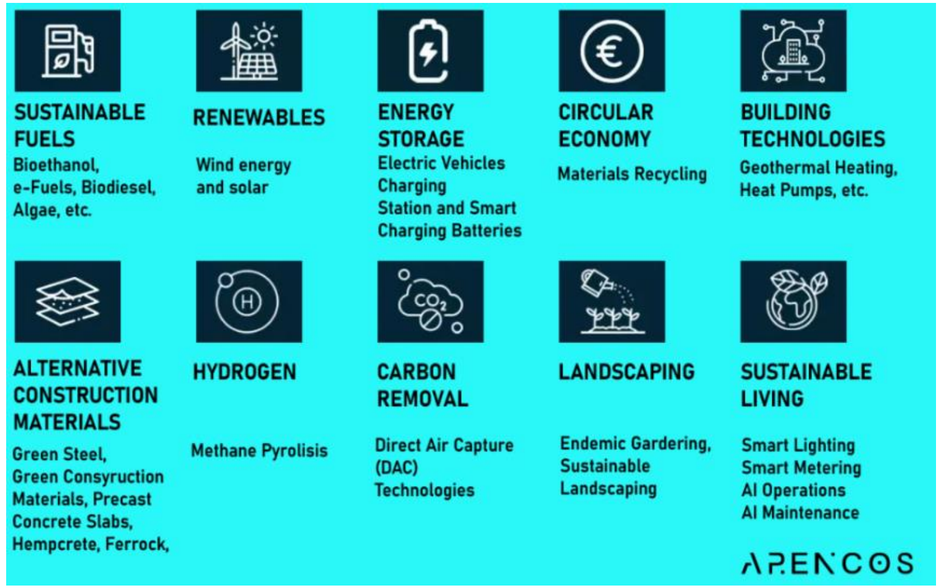
- Improvement of the building insulation.
- Intelligent shading devices.
- Integration of high-efficiency heating and cooling equipment (heat pumps combined with geothermal energy or solar collectors, solar air-conditioning, etc).
- Use of renewables (photovoltaic panels, wind turbines, hybrid systems, etc.).
- Use of “smart” energy management, i.e., advanced sensors, energy control (zone heating and cooling) and monitoring systems.

Nevertheless, there is a large number of unpredictable parameters that cannot be a priori ascertained and significantly differ for each property and its everyday operations.

For example, unpredictable inhabitants’ activities may adversely affect the building’s energy efficiency such as the needless operation of the lighting, opening and closing of windows, setting of the thermostat temperature too high or too low; the influence of prevailing weather conditions on the thermal behavior of the building, etc.

Therefore, the road towards net-zero buildings in Crete involves ground-breaking innovations and development beyond the state-of-the-art in various fields in combination with knowledge sharing and value creation.

Especially in Crete, energy efficiency cannot be implemented without taking into account the occupants’ thermal and visual comfort as well as the indoor air quality. For a successful net-zero transition, the construction sector in Crete must make bolder moves.



Meet the team

Research at ARENCOS is a collaborative and synergistic effort.

Having started as a company of two people, we are on a continuous journey of growth. White now boasts a multi- and interdisciplinary team of 14 providing research, architectural, engineering, property management and digital business services.

This success is due to the individuals that make up the team, talented people who all share a drive for excellence and reliability.

Stavros Thomas
Research Leader, ARENCOS Foresight, Research + Innovation
Stavros manages the research programs of ARENCOS.
He has a background in computer science, wind energy engineering and strategy with focus on business digitalization.

Maria Gkika
Civil Engineering & Passive House Design
Maria directs our civil engineering research programs. She has a background in civil engineering and structures with a focus on sustainable building design.

Helena Willson
Research + Innovation
Helena supports our research program. She has a background in policy and strategy with a focus on public relationships and cultures.

