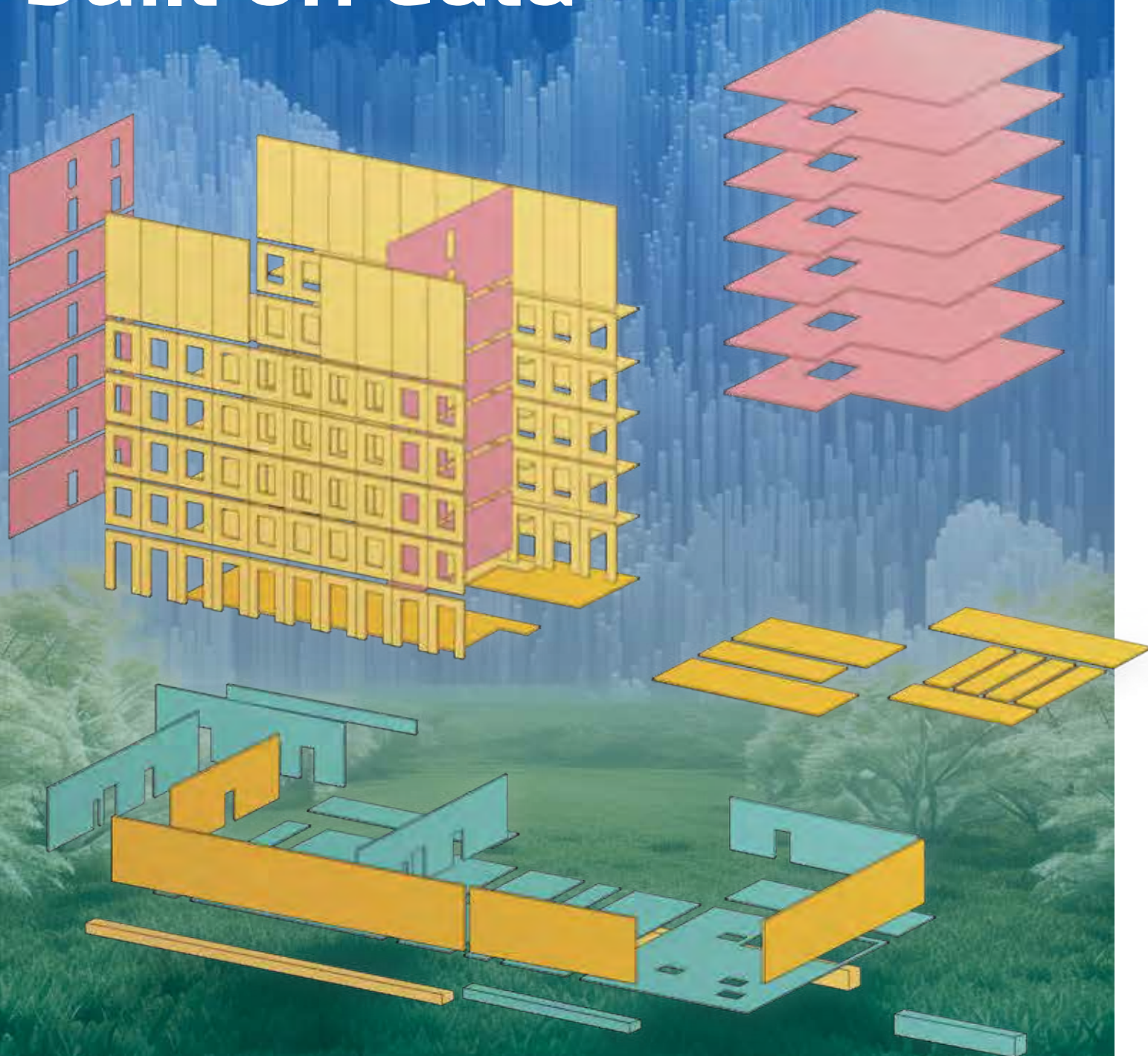


PROFILE 2024

A future built on data




ARTELIA



Knowledge means responsibility, and Artelia's extremely skilled and committed employees work every day on making it easy for our clients to make more sustainable choices. This is how we make a difference – by creating solid solutions in cooperation with our clients.



Alex Fraenkel
CEO Artelia Denmark



Artelia Group entered the top 50 consulting engineering companies worldwide in 2023. Our aim is to combine our customer-centric culture, our ambition to positively impact the planet and the society, and to provide a genuinely fulfilling work environment for our staff.



Benoît Clocheret
CEO Artelia Group





Expertise translated into greener solutions

Artelia is in an interesting development where growth and ambitions to affect the green transition are focal points for our business.

We are part of Artelia Group – a worldwide multidisciplinary engineering group with more than 8,500 employees across the world. At group level, we share the ambition to make an active difference for future generations with our engineering skills.

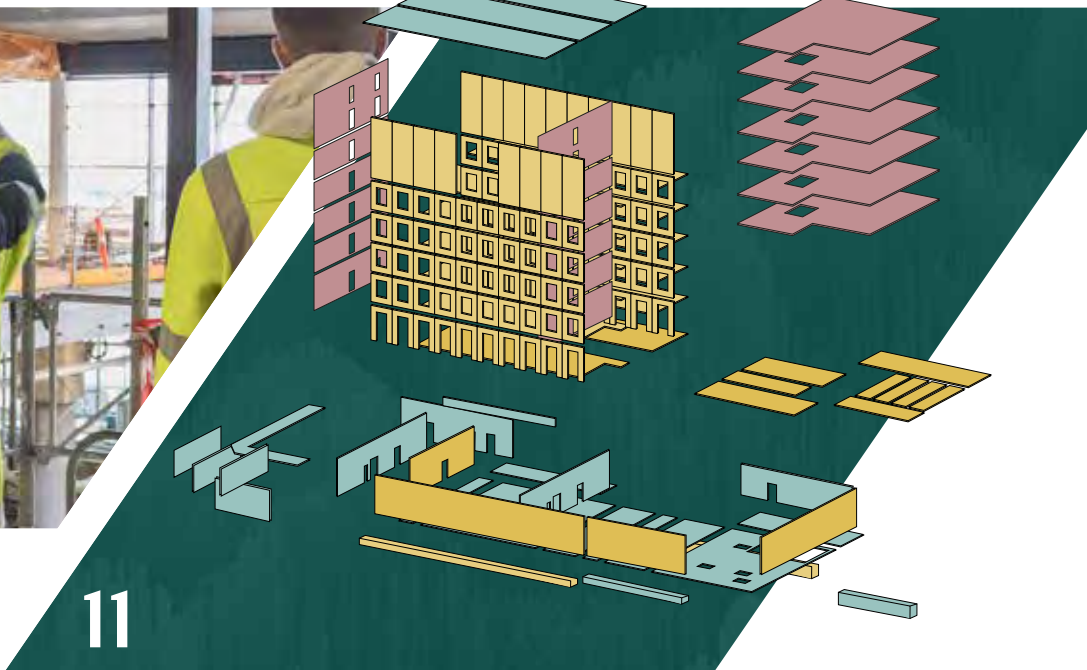
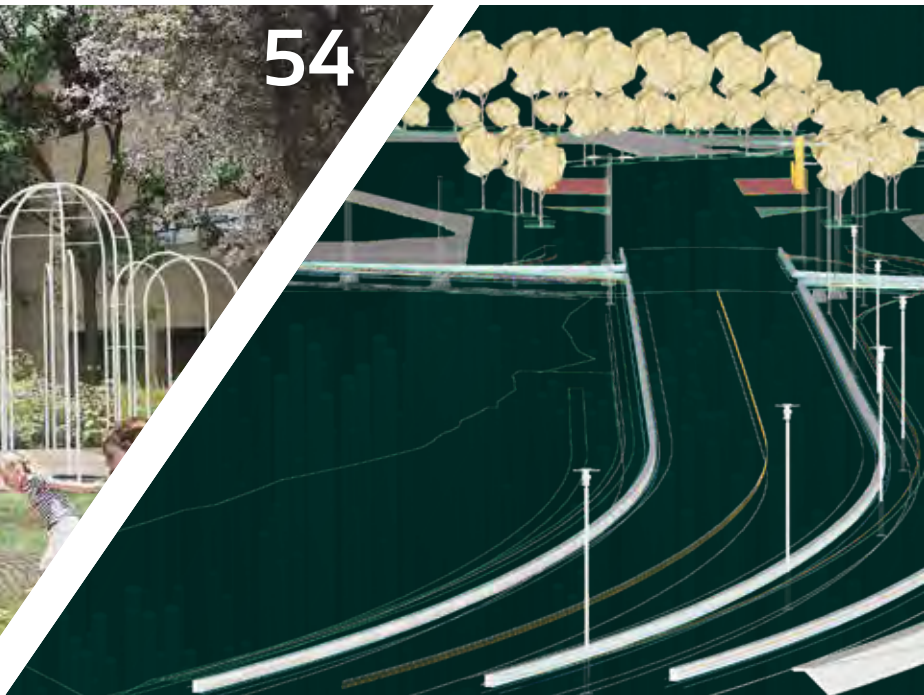
Within the building area in Denmark, Artelia has contributed to showing how the CO₂ footprint can be decreased further, and we have left a significant mark on the debate on climate requirements to new buildings. We are among the leading consultants in the energy sector. Our specialists contribute to rolling out district heating, modernising the electricity network, building more climate-friendly production units and promoting new technologies such as power-to-X and carbon capture.

Within the industry area, we help many production companies with energy optimisation and environmental questions. Pharma and life science are becoming an increasing part of Artelia's project portfolio, and we are among the largest companies in the market to cover the entire spectrum of consultancy to the pharmaceutical and biotech industry. Sustainability is also a strategic focal point for our consultancy in this area.

Within the infrastructure area, Artelia helps promote green transport modes, such as bicycling, optimise public transport and create better mobility solutions. Our contribution to the expansion of infrastructure ranges from airports and light rails to sewerage and climate adaptation.

We specialise in collecting and processing data, which form the basis for our consultancy. In this year's edition of our company profile, you can read about some of the many specific projects where we use data, expertise and an ambitious approach to making a difference for our clients, business partners and the climate.

Happy reading!





6



56



14



34



24

Contents

- 3 Welcome to Artelia
- 6 Green transition of the building industry
- 8 Part of a global group

Theme: A future built on data


- 11 Automatic mapping of material data in 3D
- 14 Digitalisation and sustainability in civil works
- 18 Analyses that promote bio-based buildings

Projects and qualifications


- 22 Climate-lowland projects
- 24 Development of Enghave Brygge Harbour
- 26 Transformation of Copenhagen Mall
- 30 Reconstruction of wood pellet silo
- 32 The great development of district heating
- 34 CO₂ reducing mobility plans
- 38 Biopharmaceutical production
- 42 Climate adjustment at a strategic level
- 44 Transformation of Musikhusparken
- 46 Maritime academy in Svendborg
- 50 Organisation and figures

Engineering knowledge – a cornerstone in the green transition


The common understanding of and the shared responsibility for our planet has become more pronounced. Legislative climate requirements are continuously being tightened, while more and more of our clients choose to set the bar even higher than what is required under current legislation.



TRÆ in Aarhus
20-floor office building in timber and recycled materials.
Owner / PFA Pension and Kilden & Hindby
Architect / Lendager



New North Zealand Hospital
On the 123,000 m² hospital construction, Artelia is responsible for DGNB auditing, sustainability management, indoor climate, daylight, environmental consultancy, climate adaptation, etc.
Owner / The Capital Region of Denmark
Architect / Herzog & de Meuron and Vilhelm Lauritzen



Autodesk Forma
Artelia started using the AI-based software for design analysis at an early stage. The tool can e.g. be used to investigate aspects that are of great importance to the consideration of sustainability.

At Artelia, we strive to lead the way and take climate science seriously. Together with EFFEKT and Cebra, we initiated Reduction Roadmap, which translates the Paris Agreement into annual reduction targets for construction in Denmark. In 2023, version 2.0 was released with the clear message that the limit value for buildings' climate footprint should be set at 5.8 kg CO₂ eq./m²/year from 2025.

At the beginning of 2024, more than 560 companies and organisations across the industry had chosen to join the ambitious goal, which may also become a catalyst for even larger innovation. We believe that this will strengthen Denmark's position as a pioneer in a world where the demand for knowledge about sustainability will only increase.

Nationwide, we have over 50 skilled specialists working with energy, sustainability and indoor climate. They are complemented by our other specialists within everything from climate adaptation and nature to circular economy and waste management. We cover all relevant parameters within various certification

schemes and create holistic solutions as well as energy-efficient optimisations for both renovation and new constructions. In addition to our extensive experience with DGNB, we have qualifications within Nordic Swan Ecolabelling, WELL, BREEAM and LEED certification.

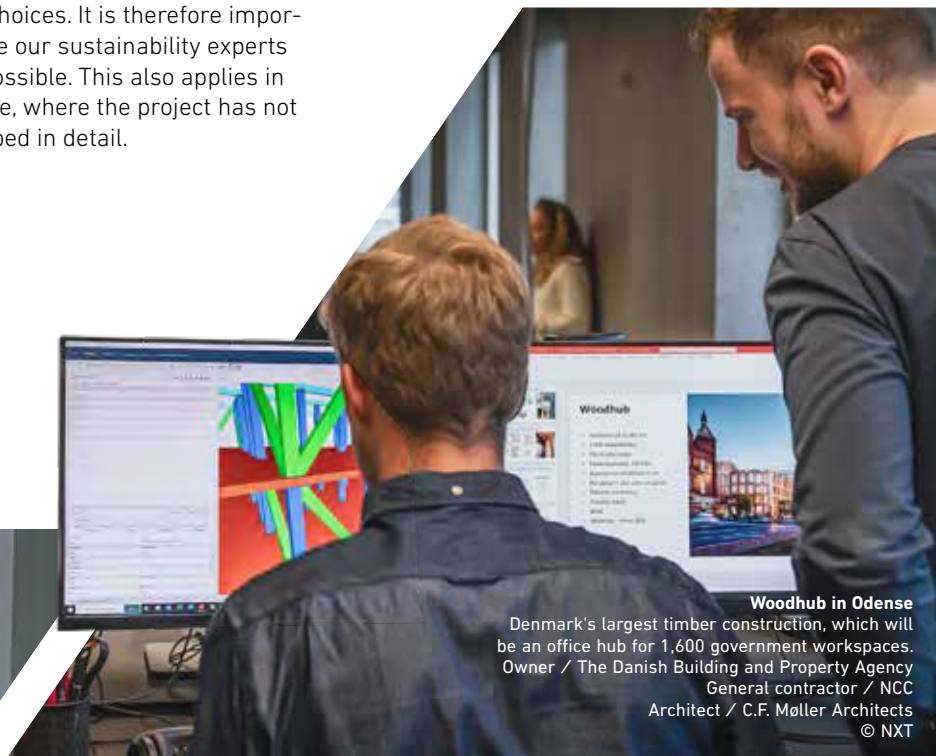
We are frontrunners in terms of putting timber construction on the agenda, we explore the use of recycled materials, we develop completely new tools for sustainability analyses, and we have extensive experience with energy-efficient solutions.

Sustainable from the beginning

It is a central part of Artelia's strategy to make it easy for our clients to make more sustainable choices. It is therefore important to include our sustainability experts as early as possible. This also applies in the idea phase, where the project has not yet been shaped in detail.

For instance within construction, Artelia's client consultants and sustainability specialists work closely together when helping an owner set strategic goals, set the right requirements in the tender or design a sustainability programme that is linked to the building programme.

Many choices cannot be made later in the process, and it will only be more expensive to change course later on. It is therefore also a matter of finances to get off to a good start, and it requires a solid knowledge base. At Artelia, we have an extensive data basis that plays a significant role in our sustainability consultancy.



Woodhub in Odense
Denmark's largest timber construction, which will be an office hub for 1,600 government workspaces.
Owner / The Danish Building and Property Agency
General contractor / NCC
Architect / C.F. Møller Architects
© NXT



Reduction Roadmap
Artelia, EFFEKT and Cebra are behind for Reduction Roadmap, which translates the climate goals set in the Paris Agreement into annual reduction goals for Danish constructions. The tool is supported by Realdania and VILLUM FONDEN.

A strong international cooperation

As part of a global group, we are able to attract more international projects and export our specialist knowledge and qualifications.



Grand Paris Express Metro Line 15

Globally, Artelia has extensive experience with metro constructions and other railway projects.

Our colleagues in France have taken part in several significant expansions of the metro in Paris.
Owner / Société du Grand Paris



Nyhavna in Trondheim

The old industrial port in Norway's third largest city will be transformed into a completely new district. In the project, we work closely together with our Norwegian colleagues from Dr.techn. Olav Olsen.

Owner / Nyhavna Utvikling
Architect / Cobe and Topic Architecture



For a number of years, we have experienced an increasing interest from international clients regarding our Danish expertise within airports and mobility. Recently, the demand has increased for other services where we in Denmark stand really strong. This applies, among other things, to climate adaptation, sustainability and digitalisation, but also noise management and cost management.



The cooperation with our foreign colleagues and business partners helps develop us as an organisation and gives us the opportunity to be part of even more large international projects.



Kim Schwartzlose
Executive Director Artelia Denmark
Responsible for international development

Large international projects include our contribution to designing Reykjavík's new state-of-the-art transport system with rapid buses, also called Bus Rapid Transit (BRT), and in several places in France, including in Le Mans and Paris, we have contributed with our specialist knowledge of cycle traffic.

In Norway, we contribute to the transformation of Trondheim's old industrial port into a new vibrant district together with our Norwegian colleagues from Dr.techn. Olav Olsen as well as Cobe Architects – one of our strong business partners. At the same time, we have several projects underway in Norway, Iceland, the Faroe Islands and Greenland.

In 2023, we submitted our proposal for the M5 metro line in Copenhagen. That is a good example of how we in Denmark can now draw on both skills and muscle when required for large projects. The proposal was a huge task that required close coordination and gathering of experience. We learned a lot from it, and even though we did not win, the process helped improve our international cooperation, says Kim.

After the metro M5 tender, clients now ask us directly to participate in other similarly large infrastructure projects in Denmark, for instance other metro tenders.

The increase in international activities have also contributed to our current organisational structure, where the responsibility for international tasks is distributed across our three business areas: construction, energy and industry as well as infrastructure.

We focus on how our Danish expertise can make a difference abroad, as well as how we can benefit from the specialised skills of our talented colleagues in the rest of the Artelia network. This includes areas such as maritime constructions, like ports and coastal protection, power-to-X, carbon capture and large infrastructure projects, such as metro constructions and railways.

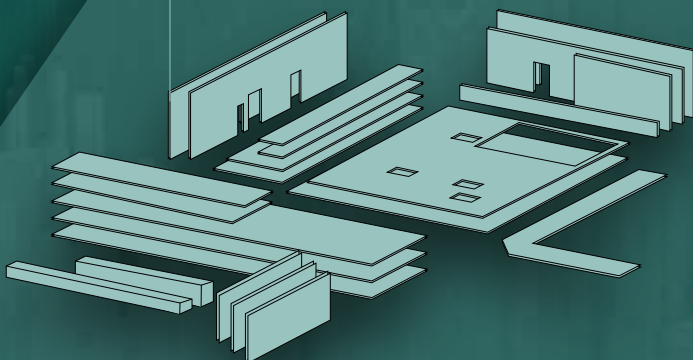
Waste-to-energy facility in Nuuk and Sisimiut
Project design of steel for two incineration plants, which help solve Greenland's significant waste challenges and at the same time produce district heating and hot water for the inhabitants in the two cities.
Owner / ESANI
Contractor / Babcock & Wilcox



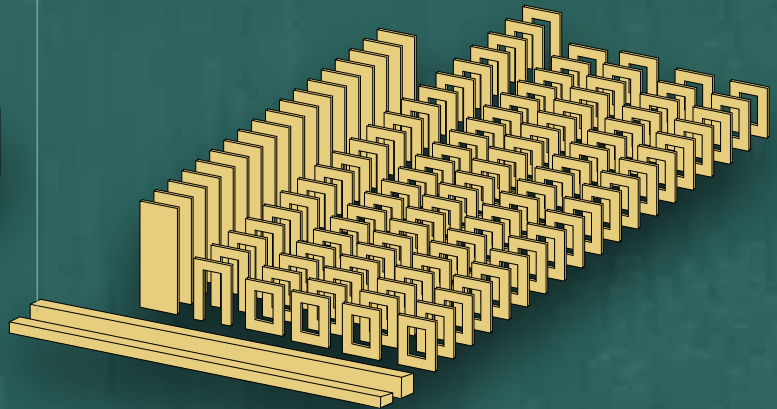
A future built on data

Words take up a lot of space in the climate debate, but at the end of the day, only numbers matter. This is one of the many reasons why we emphasise structuring, processing and presenting data to create the greatest value possible. We develop our own new data sets and digital tools that make it easier to handle complex information, and we take part in several innovation projects that provide new data-driven insights for the entire industry.

REINFORCEMENT LEVEL	2%
MATERIAL	INSITU
EPO NUMBER	AD 22074 OR (EN15804+A)
TYPE	CONCRETE
CO2-EQ	152 KGCO2-EQ
DAT/OFO	MECHANICAL COUPLING
EXPOSURE CLASS	XAI
ENVIRONMENTAL IMPACT	SLIGHTLY AGGRESSIVE CHEMICAL ENVIRONMENT



MATERIAL	BIO	SPECIFICATION OF MATERIAL BIO-BASED, MINERAL, METAL
EPO NUMBER	AD 20007 EM REV1	SPECIFICATION OF THE MATERIAL'S ENVIRONMENTAL LABEL
TYPE	CLT	SPECIFICATION OF MATERIAL, E.G. CLT, GLULAM, MLT, DLT
CO2-EQ	301 KGCO2-EQ	INDICATION OF CLIMATE FOOTPRINT IN STAGES A1-A3+C3
DAT/OFO	MECHANICAL COUPLING	POSSIBLE TO DISMOUNT AND ADAPT
WOOD SPECIES	LARCH, COMMON SPRUCE	DESCRIBES WOOD SPECIES, SPRUCE, LARCH, OAK, ETC.
REMAINING LIFESPAN	15 YEARS	DESCRIPTION OF THE MATERIAL'S REMAINING LIFESPAN
REUSE POTENTIAL	-3456 KGCO2-EQ	DESCRIPTION OF REUSE POTENTIAL EPO MODULE 0



An early indication of the climate footprint

We have developed a web application that integrates various data sources with the digital building model to make it easy to rank building materials based on parameters such as CO₂ footprint, price, recycling potential and time.

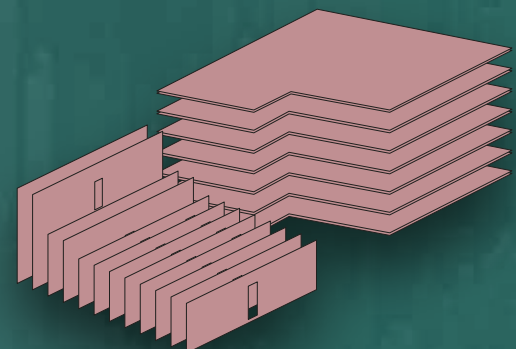
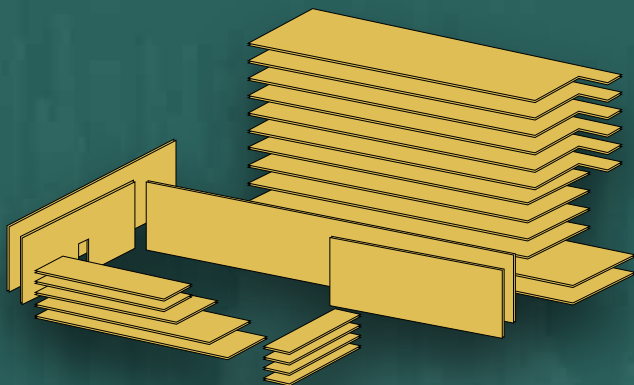
In November 2023, we had the honour of presenting an innovative solution to digitally interested people from all over the world at Autodesk University in Las Vegas where we showed a web application that is the result of a close interdisciplinary collaboration between our specialists in cost management, sustainability, BIM and digital development.

The application automatically retrieves data from various sources and turns the complex information into simple 3D visualisations. With that, it becomes easy to sort and rank building materials based on their different properties.

User experience in 3D

One of the data sources is the digital building model, which the design team works in and refines continuously with more and more information. The direct link to the working model is also the basis for an interactive 3D model that is constantly updated with the latest changes.

Continues on the next page [→](#)



Even at an early stage when you only have a roughly sketched model, you can take the entire building apart and show the materials' price or climate footprint from high to low – by using the simple colour scale of traffic lights. The ability to shed light on sustainability and financial matters is possible as the application draws on Artelia's own Data Hub, which, among other things, is able to deliver information about LCA, prices and construction time. Part of the basis comes from our cost management department and their price database based on our experience from other Artelia projects. Petras Bagdonas, one of our specialists, participated in the development of the application:



It gives all parties a good visual overview at an early stage, when crucial decisions are made. The further along the process is, the more expensive it will be to change course, and therefore time and money can be saved in the long run.



Petras Bagdonas
Senior Consultant
Cost Management
Copenhagen

As Petras points out, the very same functions can come into play when assessing the benefit of renovating and optimising a building rather than demolishing it. We can e.g. isolate all facades and state which types of material they roughly consist of in percentages. With the application, we can see right away the price and CO₂ contribution to the overall account.

Dynamic design

As the project is refined with more details, we get an even better opportunity to evaluate design options by e.g. including heat loss and CO₂ consumption for heating. The mere fact that the analyses can be made in real time at any stage gives a flexibility that is desired in many industrial projects. Lars Bøgelund Jørgensen, who is division director of Pharma & Life Science at Artelia, therefore sees a quality that does not just concern making an impact on the design in the initial phases:



Pharma projects always change along the way. Therefore, it is of great value to have a dynamic tool that can show us immediately the consequences of a new decision, no matter how far along we are in the process.



Lars Bøgelund Jørgensen
Division Director
Pharma & Life Science

A gift for the future

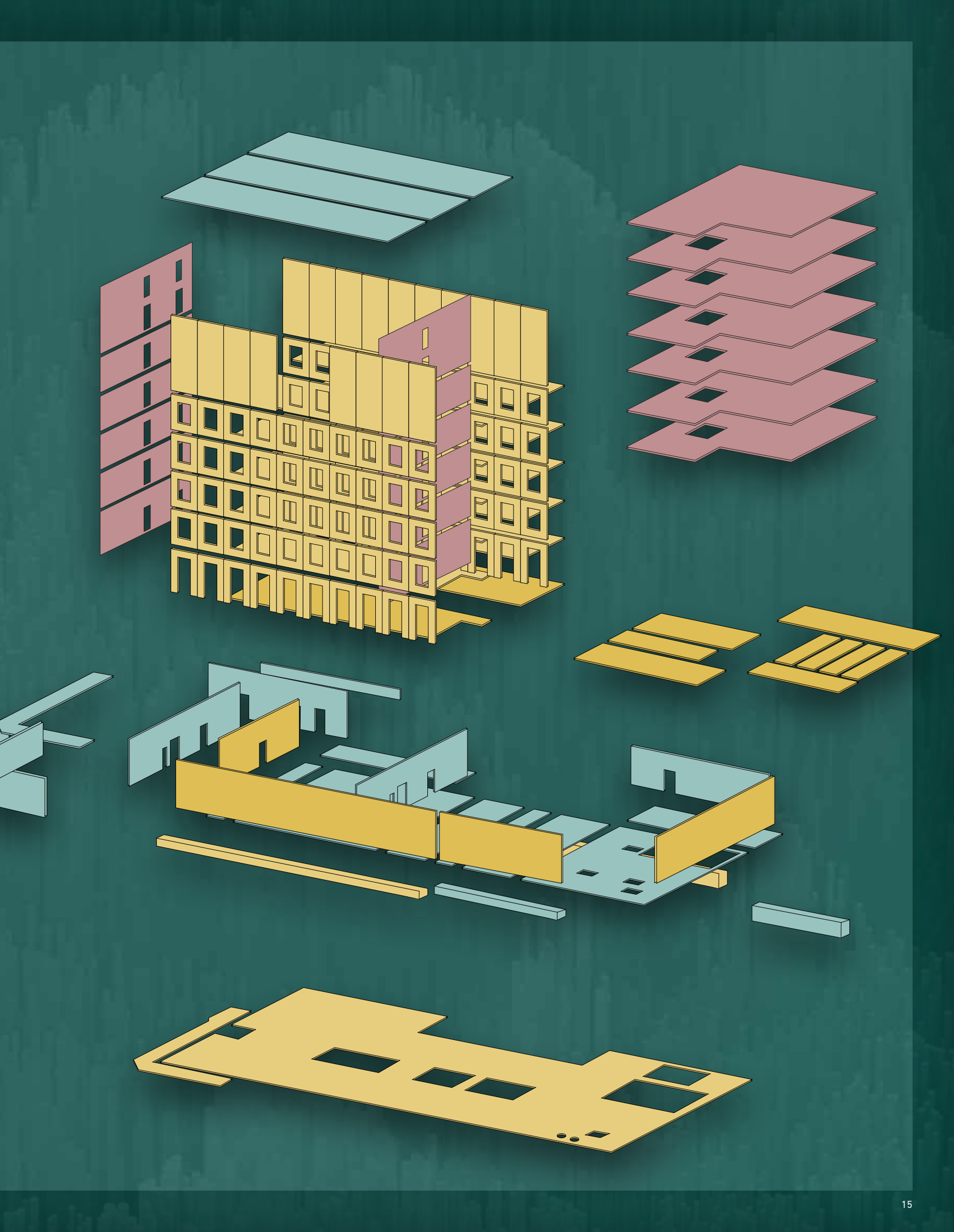
The easy access to knowledge about the building's components holds another significant potential; if you want to ensure the best conditions possible for recycling the materials at a later stage, a strong data basis and simple navigation will be a great help – especially because you can sort the components based on strength ratio, chemistry and other conditions that are of significance to recycling. Design for separation is therefore another parameter with which the application can operate, and it is an important step forward, says Brian Hurup-Felby, who is one of our experienced sustainability specialists:



The platform is ideal for the use of digital material passports. You can even see exactly where the components are located and how they are installed. This can be a gift for the future.



Brian Hurup-Felby
Senior Specialist
Energy Design,
Sustainability & Indoor Climate
Copenhagen



The path to infrastructure with a lower CO₂ footprint

There is a need for innovation and better data handling if working in a structured manner with green initiatives in building projects is to become common practice. Artelia takes part in the development on several levels.



In 2023, requirements were introduced in Denmark for LCA calculations on new construction and a maximum limit for CO₂ emissions from new buildings over 1,000 m². There are still no requirements for civil works, even though they represent a large item in the climate accounts.

It is no secret that the building area for many years have had a leading position compared to the civil works area when it comes to the use of LCA. InfraLCA, which is the name of the common tool in the civil works industry, was not launched until 2022 and is still under development. But due to the climate challenges, it will only be a matter of time before we see sustainability requirements for infrastructure, which is something we are prepared for.

Integration with BIM

At Artelia, we work with InfraLCA, and we are therefore ready to help the infrastructure owners who want to focus on climate footprint.

Our dream is that BIM will eventually become a flexible and efficient supplier of data. For BIM to really gain ground within the civil works area, there is a need for a uniform classification of civil works parts and their features, says our experienced BIM expert, Gita Monshizadeh. This means getting a clear data structure for how to describe the objects that represent the civil works parts in a digital model:

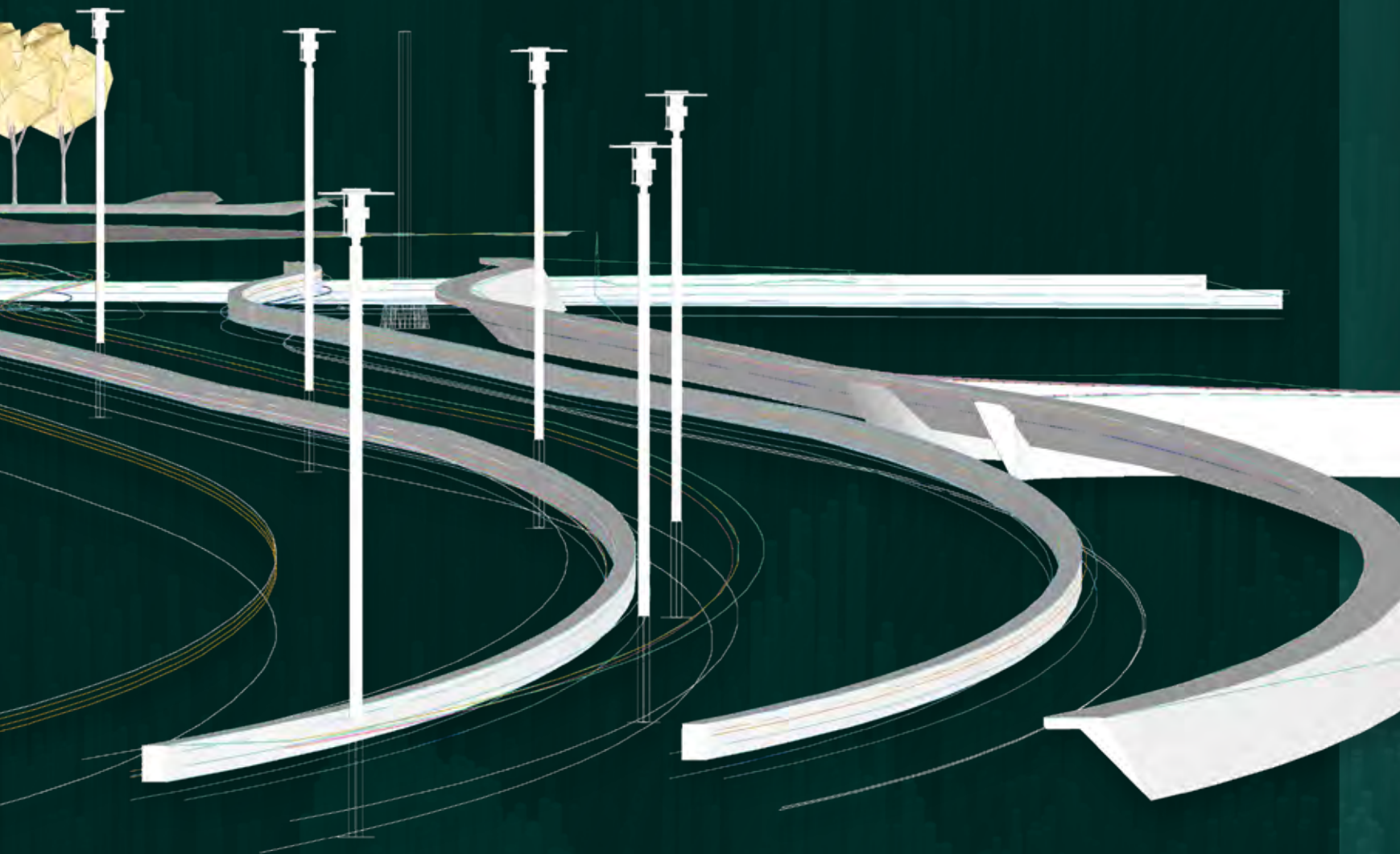


We need to have common standards for how we define civil works objects and provide them with the property data that LCA calculations require. It has to be easy for everyone to extract the relevant information and sort out the rest.



Gita Monshizadeh
Corporate Technical Director
BIM – Infrastructure
Copenhagen

Continues on the next page ...→



Cooperation across industries

Gita emphasises that not only 3D models are worth considering in this context:

Points, lines and surfaces are in principle also objects that information can be connected to. This has been done for a long time in GIS systems, and with the right structure, you can create a better link between BIM and GIS and ensure the right data for CO₂ analyses.

According to Gita, the development of standards is, to a large extent, conditional on much better cooperation across the industry. This is why she participates in several professional forums such as FRI – Danish Association of Consulting Engineers' digitisation task force, DiKon Civil Works and buildingSMART Denmark.

From layer to object structure

The joint effort may be valuable, as the use of objects with classified data has a much greater potential than the layer structure, which has otherwise been the dominant method in the civil works industry for a long time, says Gita:

The layer structure used in the civil works industry is an efficient way of structuring the geometry in civil works models. If you need to connect properties and make analyses on e.g. CO₂ savings, geometry is not enough. There is a need for an object-based classification system which can describe the objects with their associated properties, including their CO₂ impact.

Digital soil models

One of the things Gita notices specifically is the soil utilisation. Unspeakable amounts of soil are moved and disposed of in the civil works projects in Denmark, which is why she is pleased that our geotechnicians have dived into Leapfrog Geo and OpenGround, which are relatively new software in a Danish context. By combining the two programmes, you can better automate the processing of geotechnical data and model soil conditions efficiently. This is an advantage especially on the long sections and large areas that characterise infrastructure projects. Volume, surfaces and data on soil types are part of the information

that can be extracted from the models and become particularly relevant for the work related to sustainability.

The value of reused soil

If you want to illustrate how big a role soil management actually plays, you can look at the positive effects that recycling of soil may have rather than sending it to landfill. We have two brilliant examples of just that.

With the district heating project in Ørslev for the utility company Vordingborg Forsyning, we gained our first experience. Instead of disposing of the soil that was excavated during the construction phase of new cable routes, it was lime stabilised and extra gravel was added, so that it could be used as fill with the right properties. This resulted in a saving of approx. 2 billion kilometres driven in passenger cars, which corresponds to 49,906 trips around the world. The financial savings were DKK 4 million. These figures are difficult to ignore, and our district heating engineer Morten Borrís Jensen, who had a large role in the project, has made several external presentations about the experience.

Pilot project with great effect

We experienced the same good results when we used the experience on a pilot project related to separate sewerage in Strøby Egede. Oddly enough, it was exactly rainwater that caused problems during the installation of the new rainwater and wastewater pipes. The summer of 2023 was one of the wettest ever, which is why extra soil had to be removed. The parties therefore took on the task of recycling by establishing a local site for processing the soil using the same method as in Ørslev.

The pilot project ran for just under a month, and during that period, the team avoided disposing of 2,600 tons of soil and purchasing approx. 2,400 tons of new gravel and stone materials. Even with the costs of soil processing, it resulted in financial savings of DKK 116,000 together with another gain for society, says Nick Rønnow Hoffmann, who took part in the process:



In just a month, we avoided driving 15,000 kilometres in truck. That corresponds to approx. 15-16 tons CO₂.



Nick Rønnow Hoffmann
Project Manager
Drainage & Civil Works
Næstved

An extremely scarce resource

As pointed out by both Gita and Nick, it is significantly easier to get permission to recycle materials in civil works projects than in building project. In addition to CO₂ and price, there is a third important factor that strongly suggests that soil should be recycled to the greatest extent possible:

In a few years, we will have no more gravel and stone materials in all of Zealand. We will then have to ship it from Jutland or abroad, which will be expensive both in price and CO₂ emission. Far greater recycling of soil is therefore not only a gain. It is a necessity, says Nick and is supported by sustainability specialist Kristian Kromann:



A great deal can be done to reduce resource consumption in civil works projects. It is therefore also important that the industry gets better access to data that brings forward the best solutions.



Kristian Kromann
Technical Director
Sustainability
Copenhagen



Separate sewerage in Stroby Egede
A local site was established for processing the soil so that it could be recycled directly in the project.
Owner / KLAR Forsyning
Contractor / Brdr. K. hansen

STRAW CLAY SEAWEED

must
be part
of the
future

An interdisciplinary team of experts is examining how to promote the use of biogenic materials as well as the effect of producing raw materials in Denmark.



Examples of biobased building that was part of the exhibition made by the initiative Housing from 4 to 1 planet on the square Søren Kierkegaards Plads in 2023.



LCA calculations were hardly part of the consideration when the folk fairy tale about The Three Little Pigs passed from mouth to mouth back in the day, nor when Walt Disney's film adaptation hit the screen in 1933. But when fast-forwarding to today, this classic example of childhood learning must be seen in a more varied context. You cannot just conclude that the cleverest pig was the one who used bricks rather than the two who used wood and straw. On the contrary, biogenic materials are an inevitable ingredient in the green transition in construction.

This is of course somewhat exaggerated as the use of the materials requires a different kind of intelligence in order to achieve the right characteristics and qualities. Artelia is part of the team that is helping the association Realdania assess how biogenic products can play

a greater role in Danish constructions and contribute the best way possible to a reduced climate footprint – a question that contains many facets, and the analysis must also map the potential for growing the crops in Denmark.

Several different perspectives are necessary. The team includes Smith Innovation, JAJA Architects as well as researchers from Aarhus University, the University of Copenhagen, BUILD – Aalborg University and the Royal Danish Academy.

Nature's own CO₂ capture

While the production of several conventional building materials emits large amounts of CO₂, biogenic products have an advantage, as plants absorb CO₂ from the atmosphere as part of photosynthesis. Furthermore, if we turn plant-based raw materials into building materials, carbon will be stored instead of being emitted by composting or burning.

This is a significant reason why timber has experienced a renaissance, and Artelia has helped set the agenda with several pioneering projects. Timber is part of the solution, but the analysis will also look at other biogenic products, where the potential for significant CO₂ reductions is large and unrealised. This applies particularly to fast-growing crops such as straw, grass and hemp, as they absorb CO₂ at a higher rate and grow anew every year. If the climate footprint is to be reduced significantly, biogenic alternatives must be found for all building parts and not just for structures, says Artelia's project manager Steffen Maagaard:

In recent years, we have designed several projects with very low climate footprints, and in these projects, bio-based materials undoubtedly made a huge difference.

Clarification of needs at macro level

A first step in the analysis is to map the future need for building materials in Denmark and assess where it is an advantage to use bio-based products. For this work, we will, among other things, draw on our self-developed LCA database, which is based partly on our own projects, but also on best practice cases from the Housing from 4 to 1 planet initiative and projects from Videncenter om Bygningers Klimapåvirkning (knowledge centre on buildings' climate impact).

The complex question requires that we also take several different future scenarios into account, e.g. the expected degree of new construction versus renovation.

Another large part of our task will be extensive LCA calculations, which must map the CO₂ gain by choosing bio-based materials, with a special twist, says Steffen:



The analysis will have an interesting extra layer, as we have to assess what it will mean to the climate footprint if the production of building materials is based on the use of Danish crops.



Steffen Maagaard
Market Director
Energy Design,
Sustainability & Indoor Climate
Aarhus

Continues on the next page →



© Klaus Bo





Hypothetical EPDs

In collaboration with the team's experts, we must determine products that have the right qualities and the best conditions to be grown in Denmark. Cultivation, accessibility, biological factors and material properties must therefore be examined.

With our knowledge of both life cycle analyses and construction technology, we will, among other things, contribute with a mapping of existing biogenic building materials and manufacturers on the European market. From there, we will – together with BUILD – assess which resources have the greatest potential in a Danish context. Agronomists and other researchers from the University of Copenhagen and Aarhus University will then look at the other aspects of cultivation, biology and land management.

The major interdisciplinary effort will result in a net list of selected products that have the potential to be produced in Denmark in the near future and in the longer run. Each product on the list will have a life cycle assessment, which must both include the potential benefits of local production and rest on a solid empirical basis. It is therefore central to obtain detailed production data from established productions of biogenic building materials in both Denmark and abroad.

Several of the products are actually fictitious, but the goal is to get hypothetical EPDs that are as close to reality and fact-based as possible, Steffen explains.

The structure catalogue

In order to support the journey from theory to practice, a structure catalogue will be prepared, which will be a list of pre-accepted solutions. Based on the other analyses, the catalogue will demonstrate how the materials can be included in primary building parts when taking into account various performance criteria such as e.g. moisture, fire safety, energy and acoustics.

The purpose of the structure catalogue is to shed light on and demystify some of the uncertainties and concerns that may arise from the use of biogenic materials. At the same time, the catalogue will have specific examples of construction principles that have already been examined and in some cases tested in relation to meeting common and relevant requirements for modern construction. Here, we can draw on experiences from other projects such as Bio-based floor decks of the future, where several aspects were examined, including sound conditions that were tested in the acoustics laboratory in the Technical University of Denmark (DTU).

As part of the project Housing from 4 to 1 planet, we have also been involved in preparing fire safety schemes that highlight the possibilities for using bio-based materials with regard to the applicable fire safety requirements in Building Regulation 18 (BR18). Helle Bugge, who is a certified fire consultant for third-party control, took part in the work, and she wants to help conclude the importance of innovation projects:



Of course, fire safety and climate considerations can go hand in hand. But we need to be creative and have the courage to challenge conventional thinking.



Helle Bugge
Team Leader
Fire Safety
Certified for fire classes 3 & 4
and third-party control
Aarhus

Back to the natural balance

Climate-lowland projects help support the goal to reduce Denmark's emission of harmful greenhouse gasses by 70% towards 2030.

which then results in the release of CO₂ into the atmosphere. The purpose of climate-lowland projects is to reduce greenhouse gas emissions from carbon-rich lowland soils that were previously used for agriculture. This is achieved by re-establishing natural hydrology. The water level in the lowland area will rise, which will give less oxygen to the soil and with that slower decomposition or complete termination of carbon decomposition.

In addition to CO₂ reduction, the climate-lowland projects must support the purposes of nature and water environments and other climate purposes. This means that the subsidy scheme has a broad perspective and focuses on synergy with e.g. the Water Framework Directive, the Bird Protection Directive, the Habitat Directive, biodiversity, protected nature types, clean drinking water, outdoor life, organic agriculture and climate adaptation.

Mandatory feasibility studies

Artelia can help prepare the necessary feasibility study, which forms the basis for the Danish Environmental Protection Agency's decision on whether a project is feasible or not. The feasibility study includes a description of the area and the extraction of soil samples, which are used to assess the potential for retention of CO₂ and nitrogen. The feasibility study must account for whether the project is expected to have sufficient effect for a justification of financial subsidy from the Danish Environmental Protection Agency.

//
It was a bit of an adventure to collect soil samples, as a large part of the area has been under so much water that waders were necessary.

Maja Kastbjerg Holm Poulsen
Design Engineer
Environment & Nature
Aalborg

The Danish Environmental Protection Agency has set aside a pool of money for climate-lowland projects in Denmark. This means that municipalities, private plot owners and foundations can apply for subsidy for the extraction of carbon-rich lowland.

Re-establishing natural hydrology

In the past, many lowland areas were drained to enable agricultural cultivation. This practice resulted in oxygenation of the soil, which causes oxygen-consuming bacteria to start breaking down carbon,

We describe the area and take soil samples so that we can account for how much CO₂ and nutrients can be retained, design engineer Maja Kastbjerg Holm Poulsen explains.

It is not always profitable for the environment to re-establish the natural hydrology, as iron in the dry soil can bind phosphorus, which will be leached into the water environment under increasingly wet conditions. In addition, other and stronger greenhouse gases than CO₂, such as CH₄ (methane) and N₂O (laughing gas), may be emitted from water-saturated and oxygen-free soil. It is therefore crucial to analyse the composition of the soil in the area.

Productive cooperation at Simsted Å

In Central Jutland, we are helping a plot owner with a feasibility study at the brook Simsted Å.

It has been a bit of an adventure to collect soil samples, since a large part of the area has been under so much water that waders were necessary. It is a very exciting project, and the area is incredibly beautiful. The fieldwork has therefore been extra rewarding on this project, says Maja.

The feasibility study not only covers the results of a lot of soil samples, but also includes a description of how the project will affect nature and species under Annex IV of the European Habitats Directive (species that are strictly protected throughout the European Union), the water environment, surrounding areas, etc.

Both the plot owner at Simsted Å and the Danish Environmental Protection Agency have expressed great satisfaction regarding the collaboration with Artelia on this project. The requirements set by the Danish Environmental Protection Agency have required ongoing dialogue between all three parties to ensure that the feasibility studies considered all requirements.



At Artelia, they have had good insight into the assignment and what it was about. At the same time, they have had ongoing dialogue with the Danish Environmental Protection Agency and me about the development of the studies, so I have felt that the project has been in good hands at all times.

Lars Jørgen Pedersen
Plot Owner



Fieldwork in waders.





In-depth analyses in Copenhagen Harbour

We help create a foundation for urban development that makes the best of the city's blue corridors and addresses the gradual increase of the water level.

Water is a defining element in the development and identity of Copenhagen. Only a few capitals can show off a harbour environment that is suitable for a swim, and the visual qualities help shape the city's architecture.

The desire to fulfil the potential is clearly seen in the neighbourhood Sydhavnen, where the blue landscape runs between the buildings on the inlets Sluseholmen and Tegholmen. For more than 20 years, Artelia has contributed to the development of the channel city, which is now growing even larger with the transformation of the quay Enghave Brygge, where the development company By & Havn is both site owner, project responsible and client. The former industrial area is to be transformed into a district with its own metro

station, which means that it will only take a few minutes to go to the city centre. The metro square will be a unifying urban space in the new residential and commercial district, where Artelia is responsible for all civil works services for the project designed by Juul Frost Architects. A project that covers an area of approx. 75,000 m² and embraces everything from utilities to roads, paths and open spaces.

In line with the style of the other islets, several channels will be established, which is another major part of our project along with three new road bridges. Enghave Brygge is already connected to Tegholmen with the bridge Alfred Nobels Bro, which we designed together with Cobe Architects some years back.

Channel and harbour structures

Our qualifications within marine and geotechnical engineering have played an important role in the creation of Enghave Brygge. For the future channels and harbour structures, we were responsible for the project design of sheet pilings, bulkheads and other measures such as stone pitching, where this is necessary.

At the same time, we have helped assess how best to use the necessary extra land for the new building plot and ensure an optimal construction pace for the infill. As part of the project, a temporary construction pit will be established at a depth of 10 metres, where the utility company HOFOR will carry out a major re-routing of district heating pipelines to prepare for the new buildings.



The pit must be kept completely dry but is only separated from the water by sheet piles. It requires several safety measures such as extreme groundwater lowering for water not to seep up from the limestone.

Climate proofing

Resistance to climate change is another important component in the design of Enghave Brygge, and the expected sea level rise is an important part of the equation. The same applies one kilometre to the north, where another example is found of our work with climate protection in the harbour Inderhavnen.

As part of the BREEAM certification of Fisketorvet – Copenhagen Mall, we have analysed how the waterfront and the mall

itself can remain robust against future water masses and storm events. Here, we have obtained and interpreted public statistics on the water level and hydraulic models for storm surge events in different climate scenarios. At the same time, that knowledge is combined with forecasts for future water level rises.

Geotechnician and marine engineer Meesha Olesen contributed to the analysis, which also includes wave impact and current conditions. As Meesha explains, Fisketorvet is not the only example of Artelia providing maritime inputs via the use of international certification:



We have considerable experience with BREEAM analyses of both quay areas and coastal areas. Therefore, we have a solid grasp of how to best uncover all conditions related to climate protection.



Meesha Olesen
Senior Design Engineer
Maritime & Geotechnics
Copenhagen

A taste of everything

A four-storey food universe with 39 places to eat and outdoor seating right next to the water. This is the recipe for the latest phase in Fisketorvet – Copenhagen Mall's transformation, which Artelia is taking part in on several levels.

Fisketorvet's new food universe and meeting place will contribute to life by the water with both street food, bars and traditional restaurants that face the mall's popular harbour bath. For that reason, the project was named KAJEN – which means the quay. The major transformation of the centre's restaurant area will result in dining experiences in four floors spread over approx. 6,500 m². There will literally be a taste of everything, as visitors can look forward to 39 new eateries and a much more varied selection than before. At the top, there is a publicly accessible roof terrace with a view of the harbour and the Copenhagen skyline.

Interaction with the local area

This project is a great example of how shopping centres change character in these years, says Lars Beier, who works with development projects for Fisketorvet:

Traditionally, many shopping centres were built inside out in the sense that all user-oriented elements are located in the middle, while technology and administration are located along the facade, generally with a closed look. But now, there is a tendency for centres to become transparent instead, so that they can interact better with their surroundings and live up to today's demands for daylight.

There is no doubt that the ambient surroundings have become more vibrant since Fisketorvet opened in 2000. The harbour bath was established in 2003, and today, the area is not only frequented by the many visitors who enjoy the waterfront during the summer months. It has

also become a busy traffic artery for pedestrians and bike riders due to the bicycle bridge Cykelslangen, the bridge Bryggebroen and other urban development. It therefore makes even more sense that much of what the mall has to offer will be accessible from the outside on the ground floor.

Retail in change

The new addition is part of a large vision with a new district plan that Artelia helped prepare. The plan opens for possibilities for expanding the centre with other types of commercial buildings and housing. As Lars points out, this shows yet another new tendency with much more emphasis on experiences, where the centres to a greater extent are combined with buildings for other purposes:



New consumption patterns have created a need to redefine what a retail building must be able to provide, and we therefore see a movement from shopping centres to multi-use purposes.

Lars Beier
Senior Project Director
Retail & Mixed Use
Copenhagen



Continues on the next page →



The plans for the other projects are not 100% fixed, but as part of the idea development, Lars and our cost management specialists have helped create business cases for different scenarios. In relation to the overall planning of Fisketorvet's development and with that the realisation of the possibilities in the district plan, there is a large context to consider. Lars therefore works closely together with Artelia's traffic planners and many other specialists.

The area is in every way a hub, and not just in terms of traffic. If we dig a little deeper, we will reach one of HOFOR's mains in the ground and a large metro construction that requires a lot of coordination, Lars explains and is supported by Helle Korndal, who represents the owner:

It is an extensive project with many aspects. It is therefore important for us to have a consultant who both understands the retail industry and can help clarify the many questions.

Helle Korndal
Head of Commercial Management Denmark
Unibail-Rodamco-Westfield

39 new leases

The complexity was also a characteristic of the new food universe, where Artelia was responsible for all engineering services, design management, construction management as well as health and safety coordination (P). The process required careful planning and consideration for the rest of the operation.

Mall constructions are also characterised by the need for flexibility to easily adapt to different needs. The tenants each have their own unique wishes, which we have also helped meet as consultants to the tenants. Edda Maria Vignisdottir was responsible for that task, and she looks back on a creative process where a digital taste of the future layout formed the basis for dialogue. Each leased retail space was designed in 3D by Unibail-Rodamco-Westfields own design studio, Concept Studio, who at the same time helped many of the tenants create or refine the aesthetic expression for the individual eatery. Artelia's more technical models, on the other hand, had a different function, says Edda:

Eateries in particular have a number of installations that influence the design, and it is much easier to review with the tenants in a 3D model.

Edda Maria Vignisdottir
Senior Project Director
Retail & Mixed Use
Copenhagen

3D versus 2D

For almost five years, Edda has been a regular at Fisketorvet, where she helps with several projects in relation to the ongoing operation and design of leased retail space for new purposes. A good example is Denmark's largest Sport 24 store, which moved into the centre in 2023. Therefore, she also knows quite a bit about the contrast between digital models of new buildings and the existing centre's old 2D drawings, which present challenges that are in no way unique to Fisketorvet:

As-built material from the analogue age is rarely accurate enough. It is a technical problem when renovating, but also when the municipality has to have all the documentation that is now mandatory in order to get an occupancy permit. The difference becomes even clearer when compared to a fully modelled new building, where data extraction is easy, says Edda.





Asset management

For the same reason, Fisketorvet works continuously to digitalise the operational tasks. For this, they get help from our department for asset and facilities management, who are helping to implement DKV plans (operation, control and maintenance plans) for the fire technical systems in the centre's facilities management system (Dalux FM). In connection with the new expansion, they were responsible for facilitation and quality control of the digital delivery to ensure a valid and adequate basis for operation and maintenance, which will be of value to the future operation, says Aziz Hüdai Idil:



All building component cards are transferred to the owner's FM system and can be picked directly at the component's location. This means that we have a lot of important information gathered on one platform.



Aziz Hüdai Idil
Senior Consultant
Asset and Facilities Management
Copenhagen

The information could be product data, drawings, service intervals and the reports that are added on an ongoing basis. As Aziz points out, the model is not only a gain in relation to asset management at an operational level. The easy access to data can also be used on a tactical and strategic level.

A retail centre is a perfect example of a property where it makes very good sense to have the exact distribution of all areas. Here, you can very easily see what exactly belongs to the individual leased retail space, and which areas are shared. Since you can map all surfaces of a certain type, it can also be used for tendering of services like cleaning or window cleaning, says Aziz and is supported by Edda, who highlights a final perspective:

Fisketorvet is certified with BREEAM, and this requires a lot of documentation. Since all new additions must comply with relevant requirements, we have gone through the same process with the food universe. In this case, we saw that the work was a lot easier when everything is digital.



Comeback to fire-damaged silo in a top-safe version

The CHP plant Studstrupværket's enormous wood pellet silo is facing a reconstruction with several significant upgrades to prevent future fires. Artelia helps establish the new initiatives, which include a nitrogen factory, a water mist system and a fire detection system.

On 22 September 2022, Studstrupværket's silo for certified wood pellets, which is used in the plant's unit 3, caught fire. In this block, heat is produced equivalent to the consumption of 106,000 households and electricity corresponding to the consumption of 230,000 households. The silo therefore plays a significant role, and even though the heat supply was initially unaffected, the owner Ørsted immediately started cleaning up and investigating, while planning the reconstruction. A project that Artelia is now taking part in, as we are consultants on the construction project and provide machine and process-related services.

The nitrogen factory

Damp comprises a sort of fire hazard and probably initiated the fire in 2022. Just a little bit of increased damp in the wood pellets can start a biological process that generates heat that can escalate quickly if not released. This may be close to impossible if the process takes place in the middle of a stack of 56,000 tons of wood pellets.

This results in high temperatures, which is extra risky when very large quantities of fuel are within reach. The phenomenon is also known from piles of compost that combust spontaneously.

A major preventive measure at Studstrupværket is a new nitrogen factory, which will remove oxygen from the silo's wood pellets and atmosphere. This means challenging conditions for organic processes, and more importantly, it can prevent fire development. The nitrogen factory works in such a way that normal atmospheric compressed air is sent through special filters and containers that absorb the oxygen and allow the air's remaining nitrogen to pass.

For all the new initiatives, we are responsible for descriptions and tenders of the technical facilities, which must be manufactured specially for the purpose, says Jens Schaltz Bertelsen, who is project manager for the machine and process part:

We provide fairly detailed descriptions of the desired functions and help clarify all technical issues. In certain cases, we define the choice of material and ATEX-related aspects. At the same time, there is a task in designing all necessary piping, which connects the nitrogen factory to the silo.



The water mist system

If worst comes to worst, another new installation will come into effect, says Jens:



The nitrogen factory is part of plan A, while plan B is a water mist plant at the top of the silo. Once a fire is impossible to stop, the system can produce a large cooling cloud that will protect the roof structure.



Jens Schaltz Bertelsen
Project Director
Energy Plants
Copenhagen

As Jens points out, the nitrogen plant is one of several new installations that will come into play before plan B becomes effective, since the use of water has complications as mentioned and therefore is a last resort.

2,000 temperature measurements

Another assignment is a new fire detection system. From top to bottom of the silo, approx. 65 cables will be placed carefully with small temperature gauges attached for every metre all the way down through the wood pellet stack. This will give a total of approx. 2,000 temperature measurements. This way, the operating organisation can observe any kind of heat development in the sea of wood pellets and intervene in time by e.g. adding extra nitrogen. Here we have mapped the length and location of cables and defined the required number of measurements.

We have also made a presentation on how the system can be programmed and implemented in the plant's control system. In reality, we have enough temperature measurements to create a 3D model if desired, Jens elaborates.

The reconstruction

Our engineers in Aarhus are responsible for the structural aspects, and they model all structures in Tekla, which contains the project's master model. For this, the installation design is imported from Revit together with models from the programme Plant, which our specialists in machine and process use. The digital platform must be used in particular to coordinate the many interfaces. Large parts of both the silo and the transport facility survived the fire, and Ørsted mapped how much can be reused and what must be thrown away. Existing structures, installations and equipment must thus be combined with new parts, which makes this part of the project special, Jens concludes:

A contractor will probably find it easier to build a new facility from scratch using own well-known methods. But since we must ensure the greatest possible reuse of the materials, it will be our job to provide a solid knowledge base regarding the existing material, since the alternative will be too many unknown factors. It is not just about describing what is already there, but also how it can be connected to something new.



The golden age of district heating

A thorough transition of Danish heat supply has gained renewed strength with the desire to become free of fossil energy. Planning is well under way, new district heating networks are being rolled out, and facilities for renewable energy sources are being established.





An impressive 1.8 kg CO₂e/m²/year. That is how much by which we are able to reduce the climate footprint for buildings that are supplied with district heating when making LCA assessments with the new emission factors that will apply from 2025. The updated factors are presented in a report that Artelia prepared for the Danish Authority of Social Services and Housing with data from the Danish Energy Agency. The prognoses show that climate impact from district heating will also decrease by approx. 80% from the period 2025-2075. The reason is the increasing use of renewable energy sources, which are used among other things with the help of the heat pumps we are helping to establish across the country.

The figures show clearly that district heating is already playing an important role, and that the expected development will become a central step in the green transition. After a number of years in which the area has not changed significantly, the attitude has turned 180 degrees, which is something we experience very much at Artelia with projects of different characters.

Planning in North Zealand

Once the decision has been made to roll out district heating to new areas, and an overall heating plan has been drawn up, more detailed planning is one of the next steps. Artelia is assisting Norfors with this process in four of the utility company's five owner municipalities.

A large part of the assignment is to examine the possibilities for establishing new facilities that operate on renewable energy. Several solutions are assessed carefully, including air-to-water heat pumps of 30 MW. Norfors has an ambitious plan to double its production capacity by approx. 130 MW district heating, which corresponds to a doubling of the current system and will supply many consumers with district heating instead of gas.

Based on the company's own suggestions for possible locations, we have examined nine different scenarios, where we have screened factors such as heat pump technology, environment, geotechnics and planning aspects. We have now entered the next phase, which is to prepare a project proposal that will be even more detailed regarding technique and will include calculations of company, social and user economy to assess the profitability of the project. With the help of the programme EnergyPro, we will also analyse how tomorrow's energy facilities can interact in the future network the best way possible.

The district heating network itself must be dimensioned at the same time, and here we use Termis for hydraulic analyses of both the future extension, the existing system and the coupling between them.

Client consultancy for Vestforbrænding

A similar plan for the massive roll-out of district heating is a bit further ahead at the waste and energy company Vestforbrænding, which is going to establish district heating for 40,000 new consumers in the period 2023-2030.

Artelia is client consultant to the company in both phases of the large expansion, which includes distribution networks, branch lines and installations for the new district heating customers. The first phase consists of three programmes covering seven municipalities and will be executed by two turnkey contractors.

As client consultant, we will help coordinate the contracts, handle dialogue with authorities, hold meetings with the client, perform peer review and not least keep track of time and finances.

Detailed design in Nyråd and Ørslev

Consultancy and calculations at the most detailed level characterise yet another large part of our numerous district heating projects. Two good examples can be found in South Zealand, where we assist the utility company Vordingborg Forsyning in converting supply in the two towns of Nyråd and Ørslev from gas to district heating. Here, we have detailed designed the new pipeline networks and put the assignment out to EU tender. We are now construction manager in the construction phase, which is well underway.

In addition, the two towns will be connected to the district heating network via two new transmission pipelines, which will connect to a much larger pipeline already familiar to us. Because in the past, we designed the transmission line which leads to the actual production facility on Masnedø and crosses under the strait Masnedø. The pipeline was therefore established via directional drilling with assistance from our geotechnicians, who used field investigations on water to analyse soil conditions. The projects in Nyråd and Ørslev naturally extend from our previous efforts and years of experience in the district heating sector.



5 MW water-to-air heat pump in Vildbjerg

Artelia was responsible for project proposal, authorities management, tender and application for financial support from the Danish Energy Agency. Owner / Vildbjerg Tekniske Værker

A greener road from A to B

Our cities are growing – both in population and in the number of daily users with errands in the city centres. That makes increasing demands on the cities' infrastructure and transport offers which, at the same time, are important pieces in the municipalities' climate and health goals.

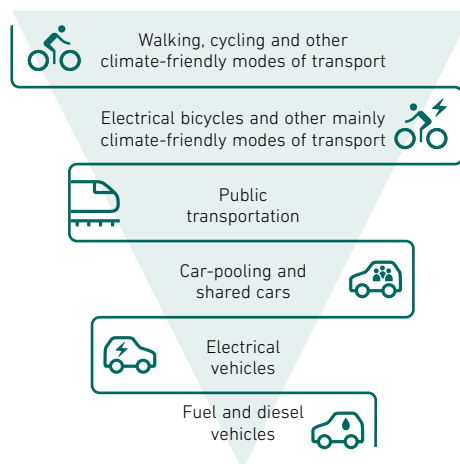




We can all agree that it has to be easy, efficient and comfortable to move around in the city. At the same time, it has to be attractive to choose a mode of transport that promotes health and sustainability. In order to achieve these goals, Artelia cooperates with several municipalities to develop green mobility plans where options and solutions are examined to meet the mobility challenges of the future.

The green footprint

The mobility plans are based on a holistic approach, where it is important to achieve an optimal interaction between the different modes of transport in order to cover all relevant needs. The green element weighs heavily and is expressed by promoting climate-friendly modes of transport that encourage physical activity such as walking and cycling as well as public transport rather than car traffic:



The climate is definitely on the agenda, but so is health. We therefore work with a mobility hierarchy, where there is extra focus on the modes of transport that support physical activity and are the least harmful to the climate.



Jakob Høj
 Technical Director
 Mobility
 Copenhagen

The green mobility plans that Jakob and his colleagues contribute to are typically prepared in collaboration with other firms from the architecture or engineering industries that specialise in urban planning. This applies to Brøndby Municipality where Artelia, together with Urban Creators, is going to prepare a green mobility plan that plays into the municipality's climate policy.

We will start by uncovering the current conditions – the basic situation. Which junctions are important for the area, what are the travel times for cars and public transportation, and are there places with poor accessibility? We will then identify the challenges that arise in relation to achieving the goals and which tools are available in order to find possible solutions. It will all be gathered in a plan with scenarios and projects that the municipality's politicians can use in the further work, Jakob explains.

At Artelia, we are experts in data-driven analyses, while the work related to e.g. campaigns and graphic communication or the process with the municipality, involvement of focus groups, etc., will be handled by our business partners.

Continues on the next page

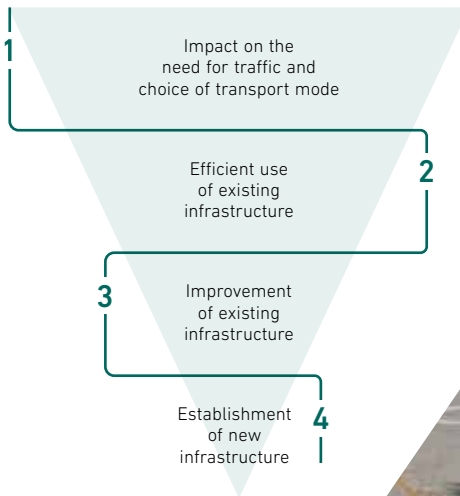
Data show the way

To a great extent, mobility planning is about common sense and about creating options. Data helps us understand needs and options.

One of the primary data sources is the Danish National Travel Survey made by the Technical University of Denmark, which is based on ongoing interviews about Danes' traffic behaviours. We also use accessibility analyses in the model TPRejsetid, which can calculate and visualise travel times with public transport and car traffic between selected destinations. The different national, regional, municipal or urban traffic models are also important tools to predict the effect of the measures that are used in the mobility plans.

New does not necessarily mean better

One of the fundamental ideas is to focus on mobility needs rather than transport needs. This means that the primary focus is on how to move people from A to B instead of on the modes of transport themselves, which paves the way for coordinating across modes of transport. When we prioritise the tools available to achieve mobility goals, we work with a 4-stage model:



It is, for example, preferable to get commuters to park their cars in the outskirts of the city and take public transport to the centre instead of expanding the road network. It makes sense both in an economic and sustainability context, explains Jakob.

International demands

Outside the borders of Denmark, there is also a demand for greener solutions to mobility challenges. Artelia contributes with our qualifications within mobility planning, e.g. in Norway as part of the development of the new climate-neutral district Nyhavna in Trondheim as well as in Riga, where we have prepared a mobility strategy in collaboration with the architects from Gehl.





From plan to reality

The joy of mobility in Odense

Odense Municipality aims for Odense to be a vibrant city with clean air and less noise. The city and city centre must still be accessible by car to ensure a well-functioning city with an active and attractive business life. This is reflected in the city's green mobility plan with ambitions to influence citizens' transport habits towards cycling or public transport, where Odense Light Rail plays an important role. A high proportion of electric cars and lower speed on roads will help reduce private and business transportation and emit less noise and particles.

Among other things, the goals must be achieved by changing deeply rooted traffic habits through physical planning and creating new climate-friendly urban spaces. Joy of mobility must be created among the city's users, and it must be easy and obvious to make the right choice when it comes to modes of transport.

The team behind the green mobility plan for Odense is led by Urban Creators and in addition to Artelia, it consists of Gehl and EY. The team won the task in a parallel assignment and will in the coming years work with the realisation of projects and initiatives in the mobility plan.

CO₂ reduction in Copenhagen

It is the ambition of Copenhagen to be the world's first CO₂-neutral capital, and traffic obviously plays an important role if the goal is to be achieved. Within the next few years, new transport options will become available with the light rail and new metro lines, but with an expected increase in both population and car ownership, there is also a need to look at other solutions.

Together with Urban Creators and EY, Artelia is carrying out a transverse analysis of the mobility in the capital area for the City of Copenhagen, the Capital Region of Copenhagen and KKR Hovedstaden (Capital Region Regional Council) up to 2035. The analysis will shed light on which measures to take in order to strengthen interconnected mobility, increase accessibility and create more climate-friendly transport across the capital area.

A significant part of the knowledge base and mapping of the traffic challenges in today's situation and for the development up to 2035 is illustrated on the basis of traffic model calculations with the City of Copenhagen's Compass model, which was developed by Artelia.

A scientist wearing a blue lab coat, a white hairnet, safety glasses, and a white beard net is working in a cleanroom. They are adjusting a large, complex piece of stainless steel bioprocess equipment. The equipment consists of various pipes, valves, and a large cylindrical vessel. The background shows a cleanroom environment with bright lighting and structural elements.

A dynamic environment where new medical products take shape

For 10 years, Artelia has assisted AGC Biologics who handles important steps in the comprehensive innovation process that characterises product development in the biopharmaceutical field.



Over the years, this has led to the production of over 200 biological products for preclinical studies and commercial approval. Protein, gene and cell therapy are among the core qualifications of the company, which has facilities several places in Copenhagen and is rooted in a company that was founded in Denmark.

In 2024, Artelia has been a consultant to AGC Biologics for 10 years, and we have solved many tasks with one special common feature, says business manager Morten Gravgaard, who is overall responsible for the client relationship:

//
Since AGC Biologics produces and develops for other players, they have to be adaptable, which of course affects our work. It is a good example of the great flexibility you must have as a consultant in an industry with constant innovation.



Morten Gravgaard
Business Manager
Project Execution – Pharma
Copenhagen

Design on the users' terms

As Morten points out, the tasks illustrate the width of the qualifications in our Pharma & Life Science division. We are usually involved right from the early idea development and conceptual design to the implementation of the technical facilities.

This can be seen in one of our latest projects, which involved setting up a downstream laboratory in existing office premises. At an early stage, our process architects helped design the facilities and production flow right down to the individual work station in close collaboration with laboratory technicians and researchers.

Based on user input, several suggestions were drawn up for the future layout, and that gave great value, says Pernille Susgaard, who is department manager for Process Architecture:


Our inspiration comes directly from the users themselves, but we also have good experience with using that knowledge to set up several alternatives. They are often positively surprised to see how we can accommodate their needs even better in a completely different way than what they had originally imagined. It is layout on the users' terms, but at the same time, we must use our expertise to offer a new perspective. Therefore, both the fourth and fifth user meetings are valuable.

As Pernille explains, the user experience must also be combined with the consideration for an efficient work flow and the many requirements that the biopharmaceutical field is subject to, including cGMP (Current Good Manufacturing Practice).

Scan to BIM

The conversion to laboratories required an upgrade of the ventilation system, which meant significant changes to a densely packed technical floor that supplies several parts of the building. At the same time, it was therefore necessary to establish a temporary supply facility that could uphold the operation of a critical production area while the other measures were implemented.

For several reasons, it was an advantage to carry out a 3D scan of the entire technical floor. The facilities were laser scanned in combination with a 360° photo registration to get a precise picture of the work area as a point cloud, which formed the basis for modelling both the current and future installations in Revit. By using the programme Revizto, both model and point cloud could be taken on the go, which made it easy to scrutinise the details on the site.

Continues on the next page 

In the process of developing new medical products, it is a long way from when the first innovative idea is born in a research laboratory to a new medical product reaches the market. The process consists of several stages, and AGC Biologics specialises in helping pharmaceutical manufacturers in a number of the stages where the potential of new ideas must be explored and tested.

Globally, the company is a leading biopharmaceutical CDMO (Contract Development and Manufacturing Organisation). This means that AGC Biologics can also handle the actual production for the customers.

An intensive summer shutdown

The 3D model was one of the tools we used when planning an efficient construction process, which had to be carried out in 18 days during a summer holiday, during which operations were disrupted as little as possible. Shutdown is a discipline in itself, as everything must be organised in detail. It requires careful planning, an understanding of the mechanical processes and insight into the industry's workflows, which our pharma specialists have.

Just establishing a construction site alone is a challenge, as all work routes must be placed in a way that does not in any way compromise the requirements to cleanliness in other areas. It requires very precise plans for how materials and craftsmen must enter and leave the building, Pernille explains.

Clean production environments

In the same property, Artelia has helped establish the actual production facilities. This comprises a so-called 6-pack unit with six bioreactors, made for single-use technology, which is replaced each time AGC Biologics has to produce a new product for a customer.

Production takes place in cleanrooms, which we have designed based on all the common regulations such as cleanability of the highest standards and a downward air flow, which means that the ventilation is established as floor suction. The ventilation qualification is also essential in our design of locks and changing facilities for the clean environments. Here, there is either positive air pressure or negative air pressure in the different rooms to eliminate the risk of particle contamination and cross-contamination.

The entire layout is of course covered by the cGMP requirements that apply in all geographic markets that AGC Biologics operates in.

The complexity of the technique

The machines in the production machinery are another one of our core qualifications. The process facility normally consists of custom-made deliveries with

special requirements, and our machine specialists' job is, among other things, to design the many necessary supplies such as heating, cooling, electricity and water. During implementation, they help with testing, commissioning and, not least, qualification, which is the process by which it is confirmed and documented that the equipment comply with the requirements for pharmaceutical production.

In construction projects, the technical equipment is an important variable in a large picture, where factors change constantly due to the dynamics that characterise the activities of AGC Biologics and the pharmaceutical industry in general.

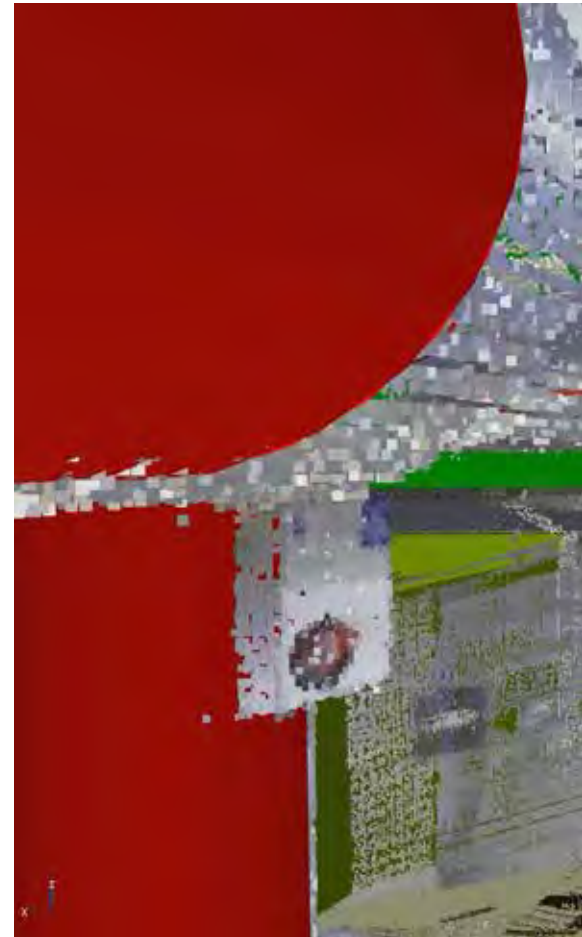


As a client consultant, I have helped assess the purchase of equipment, and it is obvious how the needs change constantly during the process. Our starting point must be that the design is not fixed until the construction is actually completed.



Pernille Susgaard
Head of Department
Process Architecture – Pharma
Copenhagen

Pernille is supported by Morten: *The prerequisites change all the time, and we therefore have to be very clear about the professional considerations behind each and every decision, so that we can go back and argue professionally for the choices that have been made. By having control of every link in the decision-making chain, we can better assess the exact consequences that a new change will entail. So, in addition to flexibility, the dynamics require a very high level of structure.*





The art of climate adjustment = an advanced equation

Climate-proofing is expensive, but so is damage caused by flood, which is why several economic considerations are at stake when assessing the level needed of climate-proofing against flooding.





A lot is at stake when complex challenges are to be solved. On one hand, finances must add up and on the other side, citizens and nature must be taken into account. There is no doubt that further climate-proofing is imperative, but the question of where and how much is inevitable, seeing that climate changes are increasing.

A well-balanced solution

Artelia has helped Middelfart Municipality find the optimal balance.

First, we had to simulate flood from cloudburst in the entire municipality in order for the results to be applicable for pointing out risk areas in the climate-proofing plan that was released in 2022, says Lasse Bo Brinch, design engineer in Drainage & Civil Works.

In cases where cloudbursts pose a risk of flood, the sewerage works Middelfart Spildevand A/S was asked to assess how the sewer system may be optimised in order to secure the areas. Artelia was hired as consultant once again.

Together with Middelfart Spildevand A/S, we based our work on service level regulation 2276 and the accompanying guidance that contain a method to be used for calculating which solutions have fewest costs when determining the service level for handling rain water in a certain area. This means that costs for establishing and operating the initiatives throughout their lifespan will be assessed in relation to the damage that floods may cause in the same period depending on the efficiency of the solutions.

Specific suggested solutions

In order to determine the most balanced level for climate-proofing, specific suggested solutions must be prepared for

several different service levels in the risk area. Suggested solutions are then modelled and dimensioned in a hydrodynamic modelling programme where Artelia has used MIKE+. Based on that, construction and operation costs can be calculated. At the same time, potential costs for damage must be calculated based on the rainfall events that will exceed the service level in the entire lifespan of the facility in question. It is therefore necessary to calculate damage caused by several rainfall events for each of the service levels that are included in the analysis. That will result in a great deal of calculations.

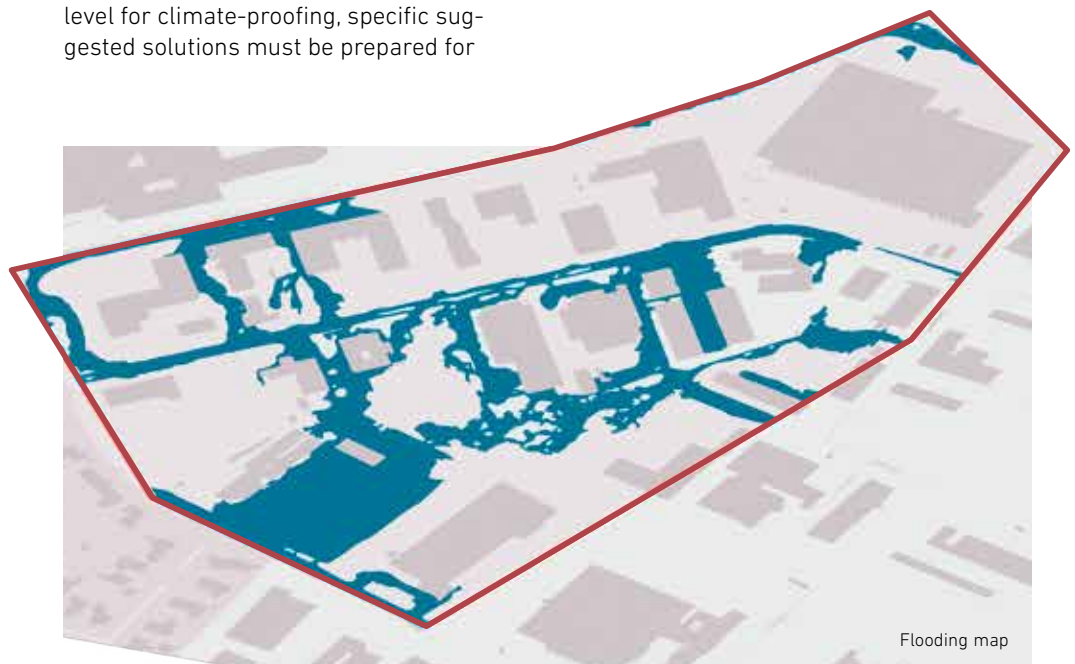


In order to have the best basis for evaluating how to prioritise, we have provided more than 25 suggested solutions and conducted 100 flood calculations in MIKE+ in relation to the assignment in Middelfart



Lasse Bo Brinch
Design Engineer
Drainage
Fredericia

The method used for the analysis of the service level for handling rainwater in a given area can also be used for potential flooding from e.g. storm surge or freshwater.



Flooding map

Culture in centre

When the transformation of the park Musikhusparken in Aarhus is completed, it will be an attractive green breathing space which will create a link between cultural institutions and strengthen the traffic connections in the city.

In cooperation with landscape architects Schønherr, biodiversity consultants Habitats and sculptor Morten Stræde, Artelia participates in the upcoming transformation of Musikhusparken which will form a vibrant gathering point for all inhabitants and guests of the city.



The interesting fusion between unique art, culture and urban development makes this urban space project very special.



Peter Hoy
Head of Department
Roads & Traffic
Aalborg

The vision must be seen in relation to the future expansion of the art museum ARoS, The Next Level, which will include a new underground gallery and the creation Skydome made by the American artist James Turrell.

The art installation plays a central role in the consultancy team's winning proposal where a large elliptical park originates from the green dome of Skydome. This main theme is called the Ring and will function as a unifying unit which will unite the cultural beacons by facing ARoS, the music house Musikhuset Aarhus, the dance theatre Bora Bora, the Officers' building with the music school Aarhus Musikskole and the building Ridehuset Aarhus. A park which will be ideal for both small and large concerts and events – including the annual Aarhus Festival Week.

Between ARoS and Musikhuset, ARoS Gardens will be established and consist of beds and small isotopes and will have room for stay and play. In connection with the Ring and the protected gardens by the city hall, a large, contiguous green area will be created.

Concerts, ice skating and water play

Musikhusparken will form a busy gathering point for the entire city which is why traffic and accessibility are important parts of our services to ensure that all users of the area will have the best and safest experience – during the construction phase as well as when the project is finished. The project also includes project design of paths, open spaces and civil works.

Rainwater management is another one of Artelia's qualifications that will help ensure that the selected solutions will withstand rainfall. Water will also be integrated as a natural part of the visual expression. Along the Ring, a stream runs and flows into the water artwork Vandkunsten, where people can play during the summer months, and during the winter months, a brand new skating rink can be used in the southern part of the Ring. The skating rink was realised based on a donation of DKK 20 million from the Salling foundations. This donation will also cover the establishment of a brand new playground and the completion of the park.

Both the skating rink, Vandkunsten and the need for holding concerts and events means that Artelia's electrical engineers will incorporate the necessary power supply and install this in the most appropriate places.

Schønherr is general contractor on the project and handles the architectural part as well as the primary project management. Artelia is sub-consultant which means delivery of all engineering services, including project management, tender management, construction management, technical supervision as well as health and safety coordination.

The project is expected to be completed during 2025.





Owner / Aarhus Municipality
funded by Realdania and
the Salling foundations
Team / Schönherr, Habitats
and Morten Stræde
© Schönherr



Maritime references on solid ground





When The New SIMAC opened in September 2023, Svendborg got a new maritime landmark.

SIMAC is short for Svendborg International Maritime Academy. The educational building is established on the quay Nordre Kaj in Svendborg Harbour and forms an innovative and inspiring frame for approx. 900 students and their educators. Here, the ship's officers, master mariners and marine engineers of tomorrow will be educated, and more experienced candidates are able to strengthen their qualifications via the academy's further training programmes.

The building includes classrooms, two auditoriums, common areas, workshops, administration, technical room, etc. In addition, a new and advanced simulator centre will be established with a full-scale engine room and a bridge where projectors create a visual and realistic experience of being at sea.

The many functions in the building must operate and work together, and even though work is done on noisy machinery in the workshops or engine

rooms, it must still be quiet in the rooms where the theoretical training takes place. This made special demands on the technical solutions, and the process included a lot of user involvement to ensure a good acoustic environment for all users of the building.

Unhiding the hidden

Artelia was engineer on the construction which was designed by C.F. Møller Architects and EFFEKT. It was a clear ambition that the building had to reflect its purpose by referring to the maritime environment. The structure of the building is inspired by the cross section of a ship hull, and the raw concrete elements refer to the industrial buildings and ship masts in the area. In June 2023, the building won the concrete element award Betonelement Prisen for its trim structure design, which gives an open and transparent building that interacts with the surrounding maritime environment.

Continues on the next page →



//
It required great accuracy in both the project design and the execution phases to achieve an elegant finish on things that would normally be hidden away behind walls and ceilings.

Sidsel Juhlin
Head of Department
Structures
Copenhagen



The inspiration from the industrial and maritime environment is also seen in the way that all elements that are normally wrapped and hidden are now made visible. The installations are fully visible, and the concrete columns in raw concrete steal the spotlight both outside and inside the building. Both the architect, engineer and contractor have therefore had extra focus on aesthetics, including the appearance and hidden joints of the concrete, says design manager for structures, Sidsel Juhlin, who has nothing but praise for the parties to the project:

It required great accuracy both in the project design and the execution phases to achieve an elegant finish on things that would normally be hidden away behind walls and ceilings in a completed construction but are fully visible in this project. Everyone has made a huge effort to achieve the impressive result.

Technical challenges and local attention

The challenge with designing parts of the load-bearing structure on the outside of the facade is that some of the structure is cold while the rest is placed inside where it is hot. This may result in thermal bridges with the risk of creating condensation and damp. It required close cooperation between the structural engineer and the energy engineer to create a solution that would meet all needs.

The building consists primarily of regular modules, but several of the rooms are in double height to create visual variation in the building design and to contain the functions in the house that require high ceiling. The rooms in double height are staggered for each floor which means that none of the floors are alike, which also made extraordinary demands on the engineers' calculations, Sidsel explains:

For a structural engineer, it was a challenging project because it was so unusual, but it was also exciting to think outside the box. We experienced that the project was known all over the city, and many people were curious and followed the development of the construction.

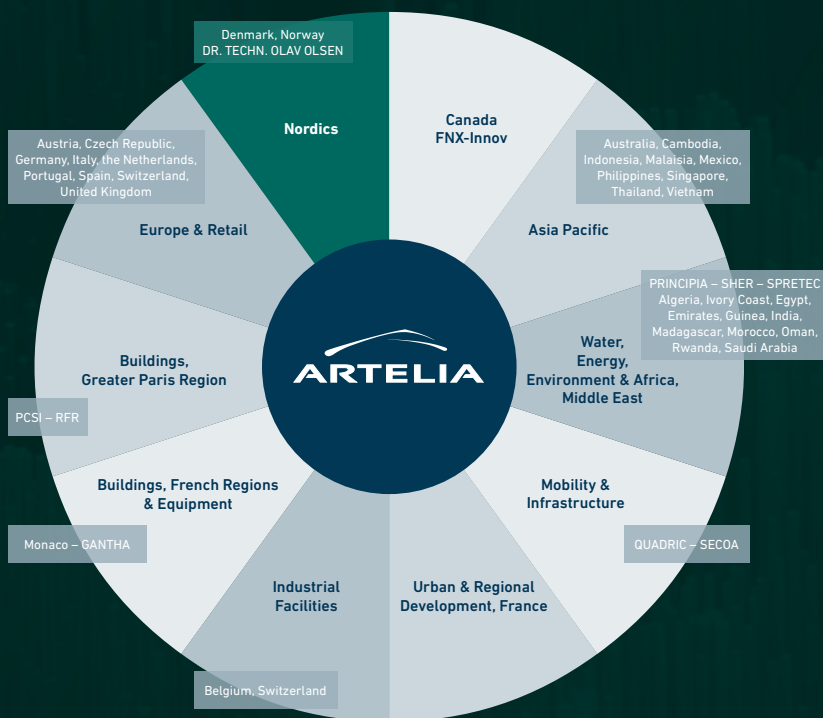
The New SIMAC was constructed by the private commercial foundation Fonden Svendborg Maritime Uddannelsescenter (SMUC) and was made possible thanks to a significant donation from, among others, the foundation Den A.P. Møllerske Støttefond. In addition, a large donation will be granted by Dampskibsselskabet Orient's Fond as well as additional donations from, among others, Den Danske Maritime Fond, Lauritzen Fonden, Sydfyns Elforsynings Almennyttige Fond and Sydfyenske Dampskibsselskabs Fond.



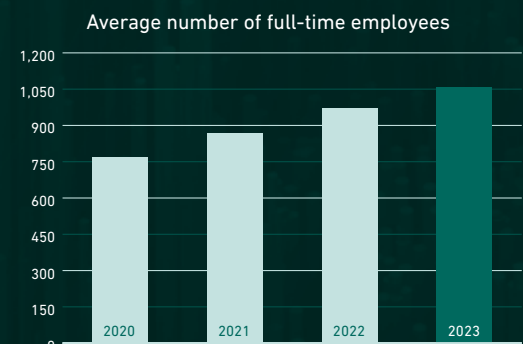
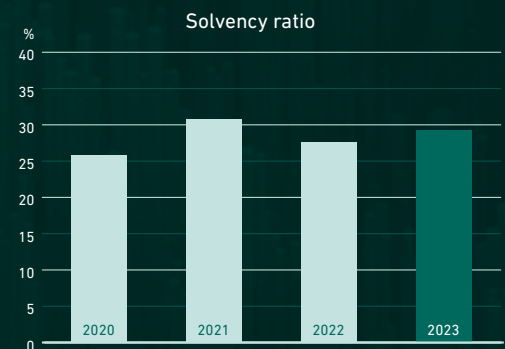
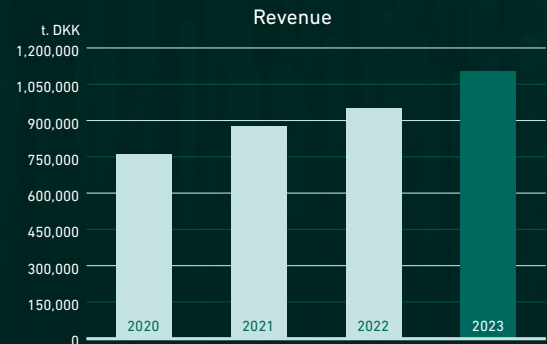
Organisation and figures

Artelia Group

We are a part of an international multidisciplinary consultancy, engineering and project management group specialising in the sectors of building construction, infrastructure, water, energy and industry with over 8,500 employees. Artelia Group is organised in 10 business units and has offices in more than 40 countries.



Key figures for Artelia Denmark

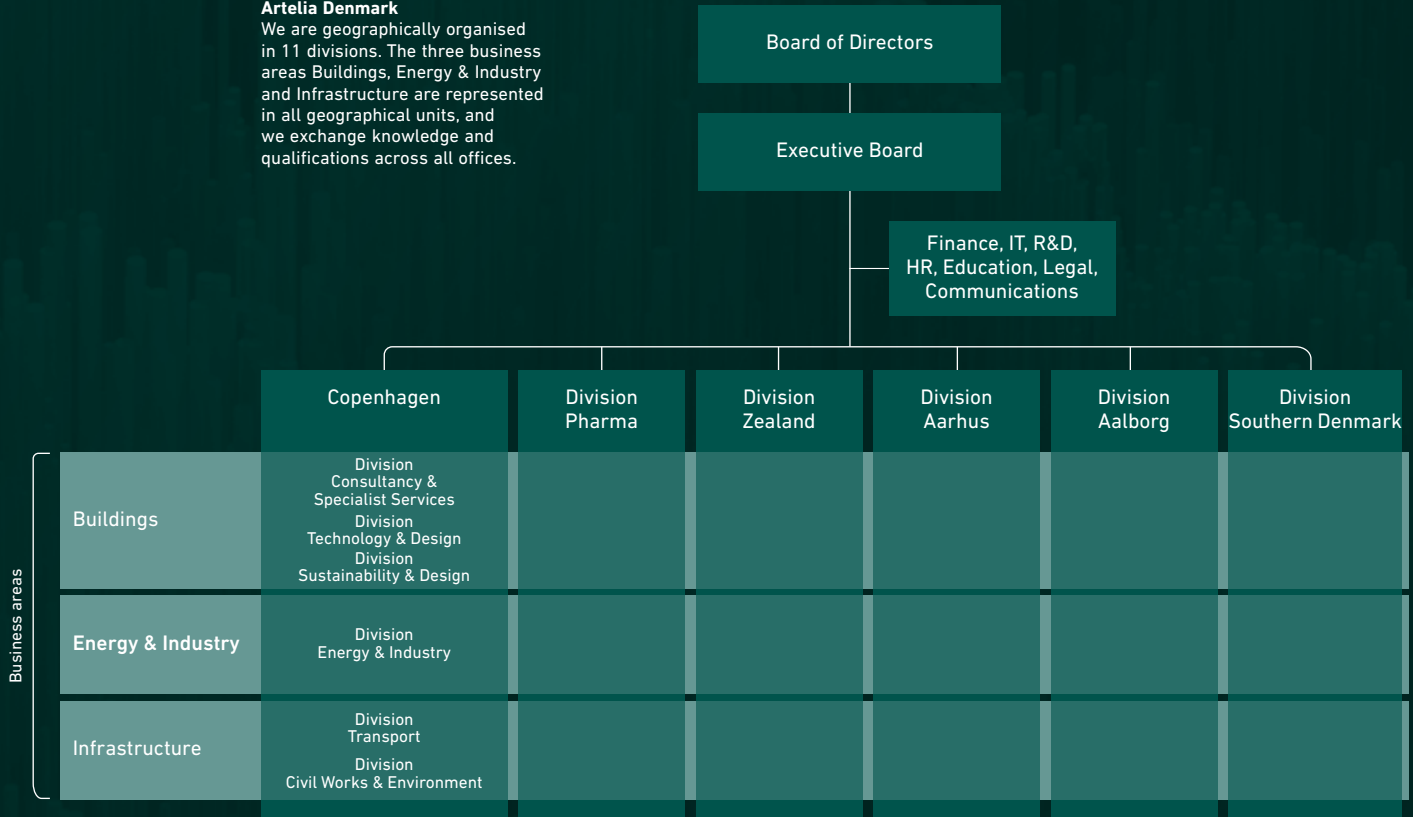


EcoVadis – Eco-label for the entire Artelia Group

Artelia has been awarded a Platinum EcoVadis, which is the highest level of recognition within the EcoVadis rating system. This rank puts Artelia among the top 1% of more than 100,000 evaluated companies in 175 countries.

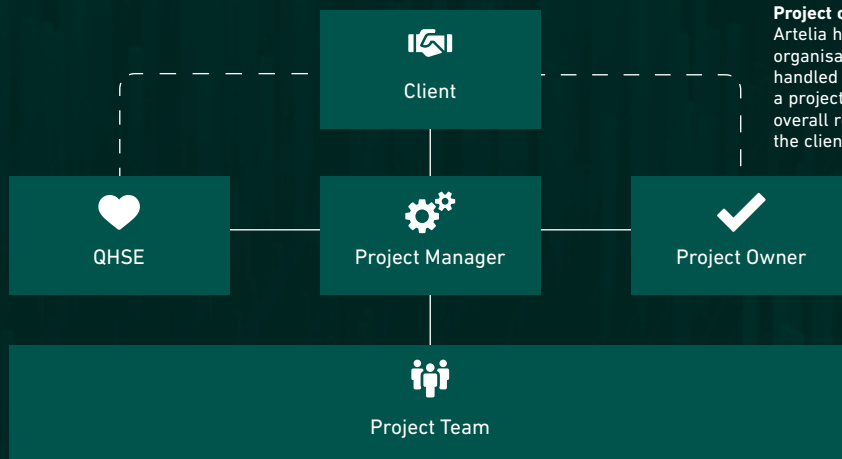
Ecovadis is the leading global supplier of sustainability evaluations for companies. Their evaluation system covers 21 CSR indicators distributed between four main themes: environment, work and human rights, ethics and sustainable procurement.

Artelia Denmark
 We are geographically organised in 11 divisions. The three business areas Buildings, Energy & Industry and Infrastructure are represented in all geographical units, and we exchange knowledge and qualifications across all offices.



Project organisation

Artelia has a simple and clear project organisation. Individual projects are handled by a project manager leading a project team. The project manager is overall responsible for the contact with the client and reports to the project owner.



Copenhagen
Buddingevej 272
2860 Søborg
+45 4457 6000

Vipperød
Skimmedevej 10
4390 Vipperød
+45 5911 0077

Næstved
Marskvej 29
4700 Næstved
+45 5572 0907

Vordingborg
Næstvedvej 1
4760 Vordingborg
+45 5537 1600

Odense
Wichmandsgade 5D, 1. tv.
5000 Odense C
+45 7593 5030

Fredericia
Bødkervej 7A
7000 Fredericia
+45 7593 5030

Aarhus
Mariane Thomsens Gade 1C
8000 Aarhus C
+45 8750 8700

Aalborg
Østre Havnegade 18, 1. th.
9000 Aalborg
+45 9812 1911