Servitisation of the cooling industry:

Cooling as a Service (CaaS)

White paper

BASE

CaaS Cooling as a Service
Refresh the planet

Clean Cooling COLLABORATIVE

Authors:

Carla Della Maggiora, Senior Climate and Environmental Finance Specialist at BASE,
Dimitris Karamitsos, Senior Energy Efficiency Business Developer Specialist at BASE,
Thomas Motmans, Senior Sustainable Energy Finance Specialist at BASE.

Contributors:

Dave Mackerness, Director at Kaer,
Dawie Kriel, Head of Engineering and Business development at Energy Partners Refrigeration (EPR),
Iain McKechnie, Director of Strategic Programmes at the Advanced Services Research Group, Aston Business School (ABS),
Dr Parikshit Naik, Business Development Manager at the Advanced Services Group Limited (ASG)

About the Basel Agency for Sustainable Energy (BASE)

The Basel Agency for Sustainable Energy (BASE) is a Swiss not-for-profit foundation and Specialized Partner of the United Nations Environment. The expertise and mission of BASE is in developing innovative, actionable financial strategies and market-driven solutions to unlock investment in climate change solutions.
BASE builds bridges between sectors and actors at the nexus between climate solutions, finance and international development. The actionable solutions that the foundation designs, develops and implements seek to be disruptive, self-sustaining and replicable.
In 2018, BASE launched the Cooling as a Service (CaaS) Initiative in collaboration with the Clean Cooling Collaborative (formerly K-CEP), to design, develop, implement and mainstream the pay-per-use model around the world to accelerate market adoption of sustainable cooling solutions. In 2019, the model was endorsed by the Global Innovation Lab for Climate Finance as one of the most innovative tools for climate finance.

About the Clean Cooling Collaborative (CCC)

Clean Cooling Collaborative (formerly K-CEP) is an initiative of ClimateWorks Foundation focused on increasing access to climate-friendly cooling.
In 2016, leading climate foundations collaborated ahead of the Montreal Protocol meeting in Kigali, Rwanda, and pledged more than $50 million to create the largest-ever fund of its kind for action on efficient, climate-friendly cooling. The following spring, the Kigali Cooling Efficiency Program (K-CEP) was born, under the management of a new secretariat assembled by and housed within the ClimateWorks Foundation. In 2021, K-CEP refreshed their strategy and updated their name to reflect their revised scope of work. Now, as the Clean Cooling Collaborative, they will continue to build on their past efforts to place cooling on the global agenda by catalyzing organizations, institutions, companies, and governments to bring efficient, climate-friendly policies, financing, and technology solutions to the world.

Descriptors:

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Contacts	Carla Della Maggiora; carla.dellamaggiora@energy-base.org Dimitris Karamitsos; dimitris.karamitsos@energy-base.org Thomas Motmans; thomas.motmans@energy-base.org

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Executive summary

The dramatic increase in direct and indirect carbon emissions from the use of refrigeration and air conditioning across sectors and regions creates an urgent need to shift from power-hungry equipment to efficient cooling technologies that rely on cleaner refrigerants. This is all the truer in light of the latest IPCC report released in August 2021.

The standard business model of selling cooling equipment does not encourage deploying commercially available, clean and energy-efficient systems due to numerous demand-side barriers. However, alternative business models, particularly servitisation, can help to unlock investments in energy-efficient and cleaner technologies (e.g., using natural or low global warming potential (GWP) refrigerants), while also helping economies to recover faster from the COVID-19 pandemic thanks to reduced operational costs.

This white paper aims to draw attention to the successful application of servitisation in the cooling industry and share on-the-ground insights from the Cooling as a Service (CaaS) Initiative launched and implemented by the Swiss not-for-profit organisation BASE – Basel Agency for Sustainable Energy with the financial support of the philanthropic organisation Clean Cooling Collaborative, formerly known as K-CEP (the Kigali Cooling Efficiency Program). The aim of this initiative was to develop, test and scale-up the adoption of the pay-per-use CaaS subscription business model around the world. The initiative has been hailed as a success by technology providers seeking to implement the model, investment funds and banks seeking to create green portfolios, and international organisations like the World Green Building Council getting involved to engage users. The model has received awards from organisations such as the Global Innovation Lab for Climate Finance and the Keeling Curve Prize and has been referenced in publications from the likes of the Economist Intelligence Unit and the World Economic Forum.

The servitisation business model has been shown to align the interests of businesses, people and the planet. The model shifts the upfront investment as well as the project performance risk from the user to the service provider, which is often better placed to shoulder these. It drives efficiency by enabling the service provider to maximise its profits by selecting the most efficient technology and optimising operational efficiency throughout the lifecycle of the asset. The provider also has the flexibility to reallocate equipment as needed, thus maximising the use of embedded resources. The model also incentivises the provider to repurpose, re-market or recycle the asset (or part of it), therefore playing a key role in the circular economy.

Several pioneering companies, including ColdHubs and KoolBox, both in Nigeria, Energy Partners in South Africa, Kaer in Singapore, MGM Innova Group in Colombia, SokoFresh in Kenya and Oorja in India, have successfully implemented the model in sectors ranging from commercial air conditioning and industrial refrigeration to cold storage for medical and agricultural supply chains.

These companies have shown that the key challenges and risks related to the implementation of the CaaS model can be overcome. These include, but are not limited to, entirely transforming the corporate culture towards a service mindset, improving the modularity of the technology, using artificial intelligence to improve the service offering, bundling projects, leveraging innovative financial structures and risk mitigation mechanisms and creating diversified portfolios.

Key stakeholders' interest in the CaaS business model has risen significantly over the past few years. More than 65 members have joined the CaaS Alliance and are actively seeking to integrate the model into their operations. Just as power purchase agreements have revolutionised the solar industry, servitisation is a game changer for the cooling industry, which is shifting to a subscription-model-based industry.

1. About Cooling as a Service

Cooling is an invisible industry essential to our modern society – from the cold chains that safely deliver our food and vaccines to the air conditioners that make our workplaces and homes comfortable, and in some cases habitable.

In this white paper, we refer to cooling as any human activity, design or technology that dissipates heat and reduces temperatures, typically including refrigeration and air conditioning.

We refer to "clean and efficient cooling" as cooling solutions that not only bring about an increase and optimisation in operational energy efficiency, but also prioritise non-ozone-depleting refrigerants with low global warming potential (GWP) in alignment with the Kigali Amendment to the Montreal Protocol (United Nations, 1987), or ideally natural refrigerants.
As urbanisation and planetary warming increase and as populations and economies continue to grow, the demand for cooling is growing exponentially on a global scale and will lead to a rapid escalation of associated energy and resource use. Air conditioning alone accounts for 10% of global electricity consumption and adds significant fugitive greenhouse gas (GHG) emissions of refrigerants used for cooling. Common refrigerants like hydrofluorocarbons (HFCs) have 200–20,000 times the GWP of carbon dioxide (CO2). It is estimated that in 2019 the electricity consumption for space cooling was responsible for 1 GtCO2 globally (IEA, "Future of Cooling", 2018). Further, the IEA estimates that global annual energy use from space conditioning alone will triple to amount to 6,200 TWh/year in 2050 under a business-as-usual (BAU) scenario (IEA, 2018). While creating enormous business opportunities, the speed, technology and method with which we meet this demand for cooling will have a major impact on climate change, air pollution and demand from the electrical grid.

There is an urgent need to reduce cooling's energy intensity, to cut pollution from the process and to ensure that efficient cooling systems are affordable to all those who need them. Cooling has in fact been highlighted by the UN Secretary-General as both a critical need for vulnerable populations and a key opportunity for cleaner growth (UN News, 2019). Phasing out HFC coolants and aligning technology deployment in

accordance with the Kigali Amendment, which aims to phase down the use of high-GWP coolants (UNEP, 2016), has the potential to reduce warming by 0.4–0.5°C by 2100 (K-CEP, 2019).

Improving the energy efficiency of cooling systems and shifting to cleaner refrigerants present an opportunity to reduce energy use and GHG emissions in buildings and supply chains while delivering cost savings, improved air quality, comfort and increased productivity. Furthermore, this represents a cumulative market opportunity currently worth 135 BUSD per year and expected to grow to 170 BUSD per year by 2030 (Economist Intelligence Unit, "The Cooling Imperative", 2019).

Unfortunately, the standard business model of delivering cooling does not encourage the deployment of clean, energy-efficient systems. Indeed, it typically involves the manufacture, sale, use and disposal of equipment with higher production volumes generally supporting more sales and more profit, while the equipment user remains responsible for covering

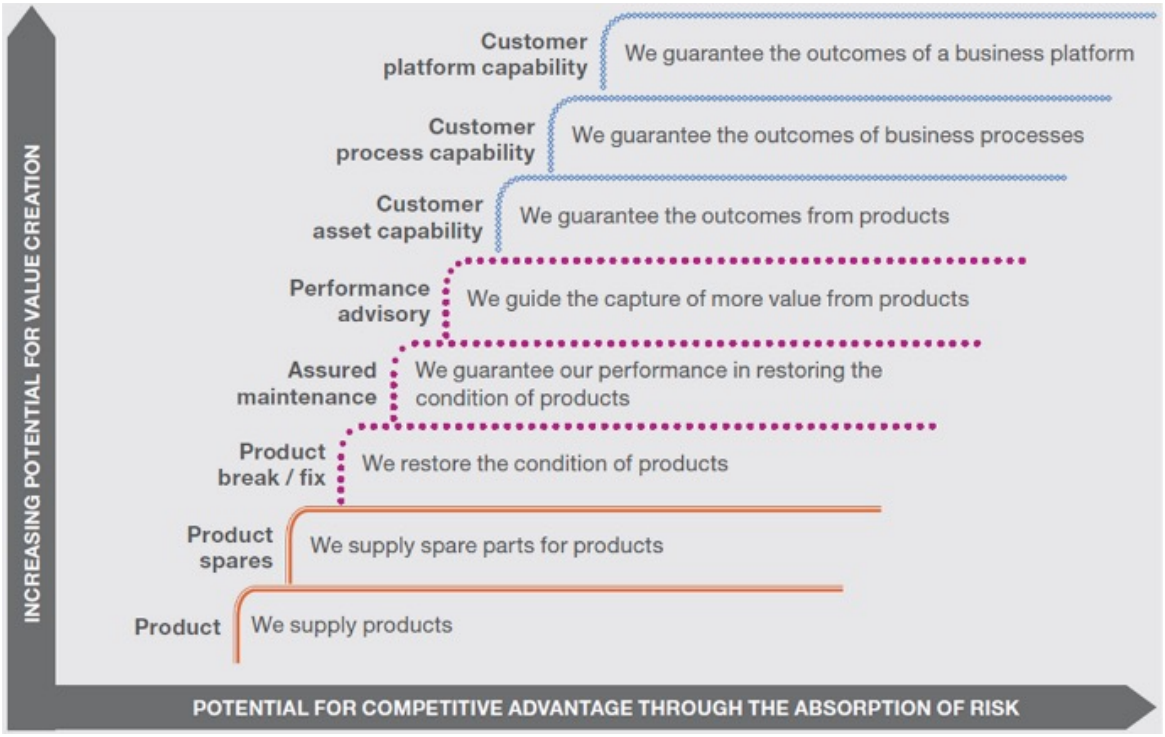


Figure 1: The Services Staircase (source: ©The Advanced Services Group Ltd)

the operational and maintenance costs. As a result, manufacturers tend to lack a strong incentive to focus on minimising cooling systems' use of energy and resources. In addition, demand-side barriers limit the deployment of the most energy-efficient technologies. These impediments include high up-front costs, the perception of greater performance risk, maintenance cost uncertainties and other investment priorities.

Alternative business models exist and can promote much more energy- and resource-efficient technologies. The servitisation* business model in particular can help overcome these barriers, align incentives and unlock investments in cleaner technologies. Through servitisation, manufacturers move away from selling products and spares and instead provide a bundle of products and services that focus on the outcome of the solution. While this may seem like a radically different business model, manufacturers can take incremental steps to reach this goal by providing supplementary services such as assured maintenance contracts and performance advisory. These steps can be illustrated using the Services Staircase (Figure 1). Servitisation occurs once the provider operates in the blue zone of Figure 1, where assets are under the ownership of the provider and contracts are based on the output of the solution. The previous steps of the staircase help organisations to gradually change operations.

The highest value for customers occurs when providers remain responsible for the outcome of the products, processes and business platforms (the top three steps of the staircase). This allows the distribution of risks to the stakeholders that are best placed to absorb them (e.g., lorry manufacturers being responsible for a fleet of heavy goods vehicles because they know the best way to ensure maximum mileage, highest performance and lowest fuel consumption).

Servitisation also enables economies to recover faster from the COVID-19 pandemic. It helps reduce operating costs without the need to invest. Servitisation also entails a higher correlation between these costs and a user's revenue streams (e.g., more clients for a hotel result in a higher revenue stream and also a higher consumption of air conditioning; more sales of agricultural commodities result in higher revenues for smallholder farmers and also a higher consumption of cold storage).

*"Servitisation" can also be written as "Servitization"; both words are used in industry. One being in British English and the other in American English. The reader is advised to search both words when seeking for literature or content on the model.

To tackle this, the Swiss not-for-profit organisation BASE (the Basel Agency for Sustainable Energy) launched and implemented the CaaS Initiative in 2019 with the support of the Clean Cooling Collaborative, formerly known as K-CEP (the Kigali Cooling Efficiency Program). The initiative focused on four pillars to support the market in adapting the model. First was the development of an open-source toolkit (consisting of a standardised contract, a pricing model and informative content) to educate stakeholders on the model and lower the barriers to adopting CaaS. Secondly, the initiative generated case studies and supported the implementation of pilot projects in various regions and industries to stress-test the toolkit's design and ensure value enhancement for all stakeholders involved. The team launched an incubator which supported five companies in Argentina, Costa Rica, Grenada, India and Nigeria in adopting the model in their operations. Thirdly, the initiative launched a dissemination campaign with matchmaking events, webinars, interviews, podcasts, videos, case studies and articles, all to raise awareness among users, financiers and implementers. Finally, the team launched the CaaS Alliance; with more than 65 active members today, the alliance has been designed to bring trust within the markets and help build momentum to scale up the implementation of the model.

Farmers in Nigeria accessing cold storage through CaaS with ColdHubs' Solar Powered Cold Rooms (click here for more information).

2. Market barriers

Investments in clean and efficient cooling present attractive returns, especially in countries where electricity tariffs are high. They generate cash savings that allow investors to recover their investment in a reasonable period, and they also improve productivity, efficiency and emissions reductions.

1

Higher upfront investments

The higher upfront costs associated with high-quality, energy-efficient equipment hinders customers' adaptation. The cost savings that result from energy-efficient equipment generally materialise over a many years, so customers do not typically see the financial benefits of energy-efficient equipment immediately. This barrier is accentuated in countries which have a high cost of capital and a lack of appropriate financing mechanisms.

2

Technology risks

There is a concern that new and unfamiliar technologies come with hidden costs or that the promised savings are not achieved. Investment decisions are typically based on the client's risk-and-return perception. The cost savings from energy efficiency are often perceived as commensurate with the perceived level of risk. The latter, combined with market risks and business uncertainties, significantly slows down customers' adaptation.

3

Investment priorities

Investments in energy-efficient equipment must compete with other customers' investment priorities, which typically are investments in enterprises' core business, where the risk and return of the investment is more familiar. These customary investments often provide higher visibility or cover short-term needs.

4

The misalignment of incentives between stakeholders

The entity responsible for paying the bills might not be the same entity that is taking the capital investment decisions. Similarly, in a standard sales business model, the technology provider does not pay the electricity and maintenance bills and therefore does not necessarily have the incentive to optimise operation and maintenance costs.

CaaS and clean refrigerants

CaaS is particularly effective in accelerating the adoption of more energy-efficient cooling, as it incentivises the provider to reduce operational costs which are mainly driven by energy use and maintenance. More generally speaking, the business model creates a direct incentive for the technology provider to think long-term and select a sustainable solution that does not quickly become obsolete. This also applies to the selection of the refrigerants being used for the cooling solution. CaaS therefore encourages the use of clean refrigerants, since these are less likely to become obsolete with increasingly stringent regulations in accordance with the Kigali Amendment to the Montreal Protocol. However, significant work is still needed to increase the deployment of low-GWP or natural refrigerants to make this the norm rather than the exception. The topic was briefly discussed during the CaaS E-Summit session moderated by the World Economic Forum; the recording is available here.

3. What is servitisation[1]

A servitisation approach in which clean and efficient cooling is delivered as a service without upfront costs can help to address these barriers. It can do this by creating long-term sustainable revenue streams for technology providers and potentially providing operational off-balance sheet financing structures for customers (UNEP, 2019).

The servitisation strategy consists of transforming a traditionally product-focused business model driven by mass production into a service-focused one dedicated to product outcome instead of the product itself[2]. Another way of framing this is the shift from a transaction model to a subscription model.

We define this business model as it is applied in the cooling sector as "Cooling as a Service". Servitisation involves end customers paying for the service they receive – the outcome (e.g., temperature within a predefined range) or output (e.g., units of cold air) – rather than for the physical product or infrastructure that delivers the service. The technology provider installs, owns and maintains the equipment, recovering costs through periodic customer payments that have been contractually agreed upon. These payments may be priced per unit of use of the service (for example, dollars per tonne of refrigeration or dollars per kilo of food stored in a cold room) or may be fixed periodically depending on the application. The payments are not dependent on the savings (as with shared savings energy performance contracts), but rather are agreed upon in advance as a function of actual usage. This makes it easier and more transparent for the client to predict expenses and visualise savings, which is a strong benefit in highly volatile and changing markets.

Servitisation is characterised by several key advantages. Since solution providers own the equipment and cover all operating costs, their decisions on the technology used to deliver the cooling will be based on a long-term vision rather than on short-term upfront investment considerations. This is particularly relevant for cooling equipment. Indeed, the main components contributing to the life-cycle cost of cooling equipment are electricity consumption and maintenance (up to 90% of costs), while the initial investment

[1] Baines, T., Bigdeli, A. Z., Bustinza, O. F., Shi, V. G., Baldwin, J., & Ridgway, K. (2017). Servitization: revisiting the state-of-the-art and research priorities. International Journal of Operations & Production Management.
[2] Baines, T., Bigdeli, A. Z., Sousa, R., & Schroeder, A. (2020). Framing the servitization transformation process: A model to understand and facilitate the servitization journey. International Journal of Production Economics, 221, 107463.

> "We need to shift the responsibility of being circular and sustainable away from the customer and onto the service provider. This is the only way to align the individual business goals with our collective sustainability goals."
>
> *Dave Mackerness, Director at Kaer*

is only a small fraction. Therefore, the total cost of cooling-system ownership is most effectively reduced by installing the most efficient systems, by optimising operating efficiency, by optimising the preventive maintenance offered to such systems to reduce downtime[3] (hence minimising the need for more expensive corrective maintenance) and by applying systemic thinking (such as by adding components like thermal energy storage or passive cooling).

By shifting the performance risk and the operational costs to the provider, Cooling as a Service provides the ability and business incentive to ensure such a long-term strategy is pursued for the solution provider, who is best placed to optimise such decisions. It is of equal importance that on traditional sales models, every system upgrade needs to go through a complex customer-procurement process where the same demand-side barriers mentioned in the previous section occur. This significantly slows down technology providers' implementation of innovation to increase performance and energy efficiency. With servitisation, the provider has the freedom and the commercial incentive to drive system improvements.

[3] Baines, T., Bigdeli, A. Z., Sousa, R., & Schroeder, A. (2020). Framing the servitization transformation process: A model to understand and facilitate the servitization journey. International Journal of Production Economics, 221, 107463.

Large real estate complex in India benefiting from CaaS provided by KAER. (click here for more information).

Another key advantage of the servitisation business model is that it incentivises designing cooling solutions for long-term use, such as through modular designs. If technology providers remain owners of their equipment, they will ensure that components are easy to reuse, replace and recycle[4]. This is key for a circular economy in which assets are redesigned for long-term use, avoiding the risk of stranded assets. This opens the opportunity for specific parts to be reused for alternative, potentially less critical applications, while modular designs also enable easier maintenance and improved recycling of components. Note that across the world E-waste is a critical issue; in Africa less than 0.1% of E-waste gets recycled yearly while in the Americas this number is barely above 9% and in Asia 11% (more info hereby). Furthermore, since under servitisation the consumption of systems is closely monitored, performance degradation is better traced for each component. This enables predictive maintenance through artificial intelligence, and it is equally important for providers to better serve their clients.

Although interest in service-based competitive strategies is not new and broadly applied in industries such as software and photocopying services, the concept is still fairly new territory in the energy-efficiency sector. In the solar sector, power purchase agreements have enabled the unexpectedly rapid uptake of photovoltaic technology by enabling customers to purchase kilowatt-hours of solar energy instead of having to invest in solar panels. This has essentially eliminated the performance risk perceived by the customers. Figure 2 below shows how servitisation has been penetrating a variety of markets in the equipment industry.

[4]Kapoor, K., Bigdeli, A. Z., Schroeder, A., & Baines, T. (2021). A platform ecosystem view of servitization in manufacturing. Technovation, 102248.

In the cooling sector, we find ourselves at the brink of this revolution.

Cooling as a Service is now attracting significant attention across regions because the model has the potential to be a true game changer for the cooling industry, making the long-term cost-competitiveness of more efficient technologies immediately tangible.

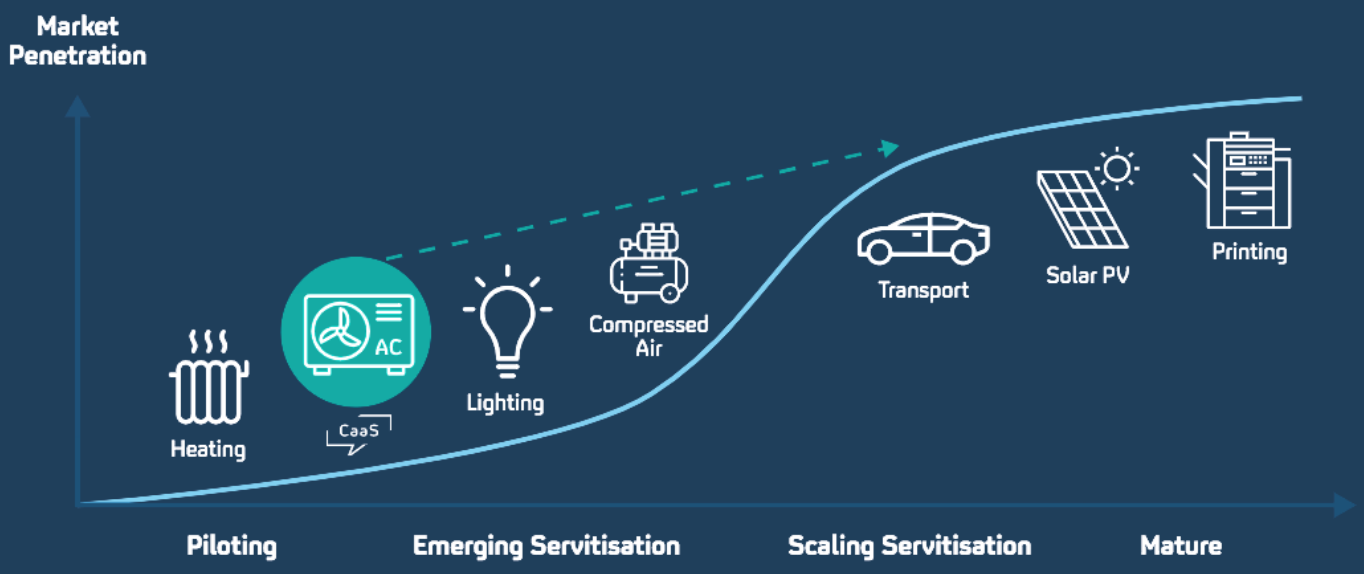


Figure 2: Servitisation across technologies

4. Advantages of CaaS

Stakeholders involved in Cooling as a Service are typically the cooling users, the solutions providers and the financiers. More stakeholders may also be involved (such as insurances and guarantee funds), but this report focuses on those most often present:

1

Cooling users

The advantages for customers are numerous. Cooling users do not need to make any upfront investment, are not exposed to the performance risk of more expensive equipment or to the technology risk of lesser-known technologies and can focus on their core business by fully outsourcing the cooling service. Engaging in a CaaS solution allows clients not only to benefit from increased savings due to higher energy efficiency, but also to reach their climate targets, all while not worrying about upcoming new regulations on permitted refrigerants (which remain under the responsibility of the provider owning the asset).

This advantage is especially beneficial nowadays, as many clients are short on cash due to the global pandemic but still under pressure to reduce their emissions while running their business. Furthermore, due to the supplier's implicit motivation, maintenance, system uptime and temperature adherence are all improved. This also yields reduced losses in products which can far outweigh the cost of cooling. Last but not least, CaaS enables customers to accurately forecast their budgets, as there are no unexpected expenses, and the model accentuates trust and transparency between the client and the provider.

To quote Deepak Kumar of Elpro Park: "When you see the contract is transparent, it builds trust and creates a win–win cooperation for the provider and customer."

2

Solution providers

Adopting the CaaS business model enables solution providers to stand out from their competition by creating additional customer value and by fully deploying the potential of their technology. As Javier Jimenez, VP of Services and Business Development at Trane Latin America, put it: "CaaS allows clients to have access to cooling delivered by state-of-the-art equipment [and] also the expertise, resources and know-how that we as the experts in this industry can provide to them."

The model can generate higher life-cycle revenues per system by enabling the provider to ensure that units in operation are used to their optimum capacity, while unused systems are repurposed to customers who need the service. It can also create predictable, continuous and additional revenue streams through the whole product life cycle and in new digitised services.

Such income streams based on long-term contracts incentivise the solution provider to continuously improve the value of their service offering. The risk of lower revenue streams when extreme events occur (such as pandemics) can be substantially reduced by operating a diversified CaaS portfolio.

It is also a strategic answer to sustainability challenges by stimulating a circular economy in which the assets are redesigned for longer-term use. The model stimulates innovation for solution providers, who have the incentive to improve systems, make them more energy efficient and increase their gains and customers' satisfaction. The provider has the ability to bring innovations to market quicker, which otherwise would require hours of operation for customers' procurement departments to properly evaluate the

A portfolio of cooling assets is more resilient, sustainable and circular compared to stand-alone counterparts.

Resilience – A diversified portfolio of assets from multiple industry sectors and regions can withstand shocks from localised market events. This was shown to be true during the COVID-19 pandemic when CaaS providers were insulated from market-specific shutdowns and country-wide lockdowns. As an example, when offices were closed, employees worked from home during the day and watched Netflix in the evening. This resulted in a massive increase in cooling requirements for data centres, which offset the reduction in requirements from offices and shopping centres.

Sustainability – Data collected from the portfolio is used to train machine learning algorithms that autonomously optimise the performance of all the systems connected to the network.

Circularity – Modular design principles coupled with "plug-and-play" capability allows equipment to be moved around the portfolio as needed. This extends the useful life of the equipment with older technology being repositioned as stand-by machines, leaving space for newer, more efficient technology to come in and drive the performance of the portfolio.

3

risk of investing in upgrades or new systems. Through long-term contracts with customers, service providers can better plan their service and maintenance teams based on the income streams the contracts generate. Furthermore, having a close, longstanding relationship with the consumer also means that any extensions or changes in the customer's processes are rapidly known by the provider, who is then better placed to adapt accordingly.

Financiers

Cooling as a Service is a very effective vehicle for financiers (such as investors, banks and funds) to create a diversified portfolio of green projects. Indeed, CaaS enables financiers to invest in assets generating well-forecasted recurrent cash flows. The model is also highly synergistic with sustainable building and construction portfolios, which is an increasingly important part of the activities of banks and investors. Traditional financing mechanisms can be applied to CaaS, such as asset-backed mechanisms (e.g., sale and leaseback) and project finance, with or without the combination of commercial debt through the creation of "Special Purpose Vehicles". Furthermore, some banks are already familiar with servitisation and recognise the value of the model. Mike Peo, Head of Infrastructure at NedBank CIB's Energy and Telecommunications, has said: "Cooling as a Service is a highly appealing opportunity which gives banks like NedBank the opportunity to invest in Green projects and fulfil their ESG and SDG targets. Servitisation is not new to us, and we are able to use known expertise to invest into CaaS projects; indeed, 12 years ago, NedBank invested into Energy Telecoms where servitisation enabled clients to access better solutions through off-balance contracts" (view the highlights of the conversation hereby).

Models to increase investments in clean and efficient cooling other than Cooling as a Service exist, but several of the benefits mentioned above don't apply (see box below).

Where does CaaS place itself compared to other business models for clean and efficient cooling?

1. Servitisation should not be confused with customers' leasing models, where performance risks stay with the cooling users. Accordingly, they do not address lowering the demand barriers that slow down market adoption of innovative technologies. Contrary to financial or operational leases, service agreements do not provide the customer the right to control the use of an identified property, plant or equipment (an identified asset) for a period of time in exchange for a regular payment. The report "Lumens as a Service" published by the Rocky Mountain Institute gives insights into the key differences between a lease and a service, in particular with regards to the IFRS16 accounting regulations.

2. Another alternative model which has been deployed on the markets is "Energy Performance Contracts". However, this model has experienced challenges in being implemented broadly and often brings friction between the cooling user and the solution provider when energy performance savings do not match expectations. Estimating savings can be especially complex to evaluate for solution providers, particularly when customers alter their business operations or their infrastructure. Cooling as a Service brings an appealing solution to these challenges for both the cooling user and the solution provider.

Office building in Medellín, Colombia, benefiting from CaaS delivered by MGM Innova Group (click here for more information).

5. The results of CaaS today

Where does the market currently stand with the servitisation business model in the cooling industry, and what have been some of the results?

Cooling as a Service has shown to be a flexible model which can be implemented in any market, particularly as both the demand for cooling and imperatives to reduce electricity consumption and fugitive emissions grow. The paper "CaaS - Lab Instrument Analysis", written as a collaboration between BASE and the Global Innovation Lab for Climate Finance, outlines some of CaaS's market potential and areas of interest. The model brings particular value in regions where energy costs, temperatures and humidity are high and regulations are already in place to shift to cleaner refrigerants.

Several pioneering companies, including ColdHubs and KoolBox, both in Nigeria, Energy Partners in South Africa, Kaer in Singapore, MGM Innova Group in Colombia, SokoFresh in Kenya and Oorja in India, have successfully implemented the model in sectors ranging from commercial air conditioning and industrial refrigeration to cold storage for the agricultural supply chain. Together, these companies own and operate well beyond US$50 million of cooling assets under CaaS. Case study documents are available for several representative projects implemented by these companies here.

A video produced by BBC StoryWorks in 2020 showcases two exemplary projects: the first is Kaer's use of CaaS to provide cooling to a real estate complex in India with an artificial-intelligence-powered chiller plant running on 100% solar energy. The second is ColdHubs' use of CaaS to enable smallholder farmers in Nigeria to reduce food waste by storing their crops in clean and efficient off-grid cold rooms under a pay-per-crate walk-in model. In India, Kaer enabled the customer to gain more than 30% improvement in energy efficiency while also using a closed loop water cooling system, thus reducing consumption of water in a circular manner. In Nigeria, ColdHubs made it possible to tackle one of the country's major challenges: food waste (which applies to many countries across the globe). It reduced its customers' agricultural waste from over 50% to less than 10% and increased their revenues substantially, while powering the cold-rooms

DataCenter in Singapore benefiting from CaaS provided by KAER (click here for more information).

CaaS and clean refrigerants

In May 2021, two leading CaaS providers, Kaer and Energy Partners, participated in a webinar on CaaS organised by the International Finance Corporation where they shared their perspective on what they see to be a multi-billion-dollar green pipeline opportunity. The recordings of the panel conversation can be viewed online.

by solar power and using natural refrigerants with a near-to-zero GWP. Nuhu Sa'eed, a ColdHubs customer in Nigeria, said: "Before we used to get a lot of loss because things would spoil in the market. We used to lose a lot of money; now it's only 5% or 10%."

In addition, the authors of this paper are aware of at least 18 other companies actively integrating Cooling as a Service into their business operations. These include five companies that were selected for BASE's CaaS Incubator programme launched in 2020, as well as 13 others that are part of the Cooling as a Service Alliance and are restructuring their teams and revisiting their business strategy to shift from selling cooling assets to selling a cooling service.

Cooling as a Service has been gaining significant momentum over the past years, moving towards the tipping point of market adoption. The model was increasingly referenced by recognised publications and articles, including for instance the Economist Intelligence Unit, Sustainable Energy for All and the World Economic Forum. The model has also been awarded by well renowned prices such as being selected as one of the most innovative and actionable climate solutions by the Global Innovation Lab for Climate Finance, receiving the Keeling Curve Prize, and being certified by the Solar Impulse Foundation.

South Africa's largest dairy company benefiting from CaaS delivered by Energy Partners Refrigeration's ammonia solution (click here for more information).

6. The results of CaaS today

Implementing Cooling as a Service does not come without its challenges (operationally and commercially), which explains why the model has not been widely implemented yet. With servitisation, companies move from a transaction model to a subscription model – from a reactive model to a proactive model. This requires important changes in a company's operations in order to successfully deploy the service to the customers.

Transforming strategy and organisational culture:

Shifting to servitisation requires important changes in the organisational culture and structure of companies, and these are reflected across several departments.

The sales teams move from equipment and parts pricing to setting a price per use, and they have to adapt the way they measure success. Most hardware product enterprises measure success through the amount of assets they sell; however, CaaS requires different key performance indicators (KPIs), such as length of contracts, amount of cooling quantity delivered, customer loyalty etc. The customer success teams transition from training and documentation to creating customer business value. The marketing teams need to reframe the messaging to the clients. The service delivery teams focus on maximising uptime instead of optimising the inventory management. The sales teams need to gain skills in financial engineering, and investment negotiations need to be included in the finance department.

Last but not least, there needs to be an adequate data management operation in place to ensure effective measurement and reporting of the cooling delivered (for accurate billing) and also a reliable measurement of efficiency which drives the provider's profit margin. Kaer is an example of a company that has successfully made this cultural shift, first slowly integrating CaaS as one additional business unit within the organisation and later shifting to offering only Cooling as a Service and entirely rebranding itself as such.

Transforming technology design:

The full potential of CaaS is fully tapped only if the research and development department[5] is involved and the technology design strategy is adapted accordingly. Indeed, if a company shifts to Cooling as a Service, its R&D department should focus on "make to serve" instead of "make to sell", for example by making equipment more modular. For this reason, shifting to servitisation is a fundamental step in transitioning to a circular economy.

Transforming the contractual arrangements:

Ideally, CaaS is structured as an off-balance service to the client, which means that the well-known contractual arrangement of leasing does not apply, and the assets remain on the provider's balance sheets (or are transferred to those of a financier). This requires a reliable, standardised contract with well-evaluated risks which complies with the latest IFRS 16 accounting regulations. To develop this, a company requires the adequate resources, experience, time and capital. Organisations often lack these or require internal strategic prioritisation, which may be a challenge due to shareholder pressure. A standardised CaaS offtake agreement is available on the CaaS website to facilitate adoption of the model.

[5]Bigdeli, A. Z., Kapoor, K., Schroeder, A., & Omidvar, O. (2021). Exploring the root causes of servitization challenges: an organisational boundary perspective. International Journal of Operations & Production Management.

Setting up appropriate pricing structures[6]:

Shifting from selling equipment to selling a service also requires revising the pricing strategy. The price per unit of cooling sold must be appropriately estimated; such pricing can be value based. A cost-based pricing tool is available on the CaaS website to estimate the price per unit of cooling.

Both the standardisation of the contractual arrangements and the development of robust pricing models are key to facilitate the successful execution of a project, as well as for investors to better evaluate the risk and return of such projects and to consider CaaS projects as valuable, sustainable and scalable investment opportunities. While developing the pricing model and the standardised contract, companies need to properly evaluate projects' technology and market risks which may occur during the lifetime of the project, and these must be included in the contract and pricing structure to protect the investment against these.

Preparing the product offerings:

To implement Cooling as a Service, a company needs to properly evaluate the products within its portfolio which fit best and are most ready to be delivered "as a service". The system needs to be reliable, remotely digitally operable and have clear cost structures and maintenance requirements (more details can be found on the research paper from the Advanced Services Group from the Aston Business School).

Market approach:

The first client(s) to be provided with "as a service" need to be well-known by the solution provider so that performance requirements and usage profile needs can be properly evaluated and predicted. Furthermore, either clients need to already be aware of such models or efforts must be brought forward to educate the end customer in the value of the model; the latter involves the end user altering how their procurement department typically invests capital. In addition, first-time clients typically perform as partners in long-term agreements: should challenges occur with the initial implementation, agreements between the provider and the client can be concluded without needing to resort to legal action.

At the CaaS E-summit event on 1 December 2020, Tomas Naucler, Partner at McKinsey, explained some of the building blocks which are required for a successful transition to products as a service: "Having the right product offering, the right price, creating differentiated offerings, migrating existing customers to the model and promoting the new business model within your organisation and beyond is essential."

Recapitalisation mechanisms:

Including a recapitalisation mechanism is key to successfully implementing a CaaS project. Shifting from selling an asset to selling a service means that the income flow for the provider changes, requiring initial capital to make the investment upfront to deliver the service to the customer, while accruing revenue over time from the client's paying for the service consumed. Companies that have the capital in-house may do so on their own (or those that have their own financial institution); otherwise, in order to scale up, other financial partners need to be brought on board (such as banks, investment firms or other financial stakeholders). There are different financial structures that enable recapitalisation of CaaS providers, in addition to equity and commercial debt. Two of the key financial structures currently in use in the market include:

[6]Ziaee Bigdeli, A., Baines, T., Schroeder, A., Brown, S., Musson, E., Guang Shi, V., & Calabrese, A. (2018). Measuring servitization progress and outcome: the case of 'advanced services'. Production Planning & Control, 29(4), 315-332.

1. Sale and leaseback:

Sale and leaseback is a form of asset-backed finance. After having signed one or more CaaS contracts with customers, and once these are generating cashflows, the CaaS provider can sell the cooling assets to a bank and then lease them back from that bank. The CaaS contracts between the customers and the CaaS provider serve as collateral to the bank in addition to the cooling asset. Relevant payment guarantees reducing default risk for the technology providers can also be made out to the bank.

2. Special purpose vehicles:

Using project finance to set up a special purpose vehicle (SPV) is one of the most common structures used to implement CaaS, and it is widely applied in infrastructure project finance. In such a structure, an SPV set up by private or institutional investors purchases the equipment and signs the contract with the customers. Typically, the investors would expect the CaaS provider(s) to supply a portion of the equity for the investment vehicle (through their own capital or debt); this brings confidence to the financier that the contract provides the solution provider with the right incentives to deliver quality performance. A separate agreement is signed between the SPV and the CaaS provider(s) to guarantee the proper supply, maintenance and operation of the system.

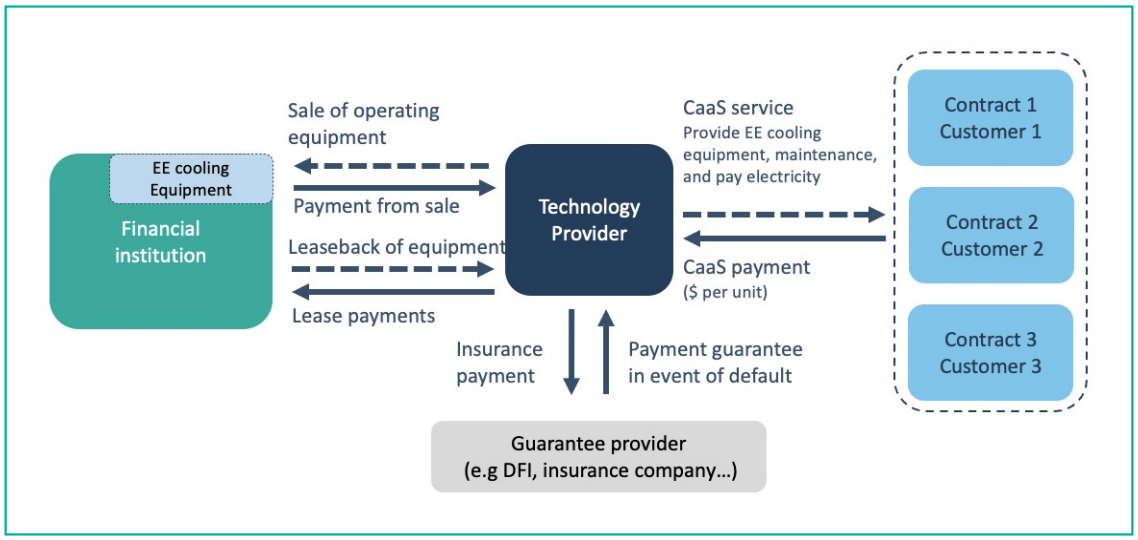


Figure 3: Sale and leaseback structure

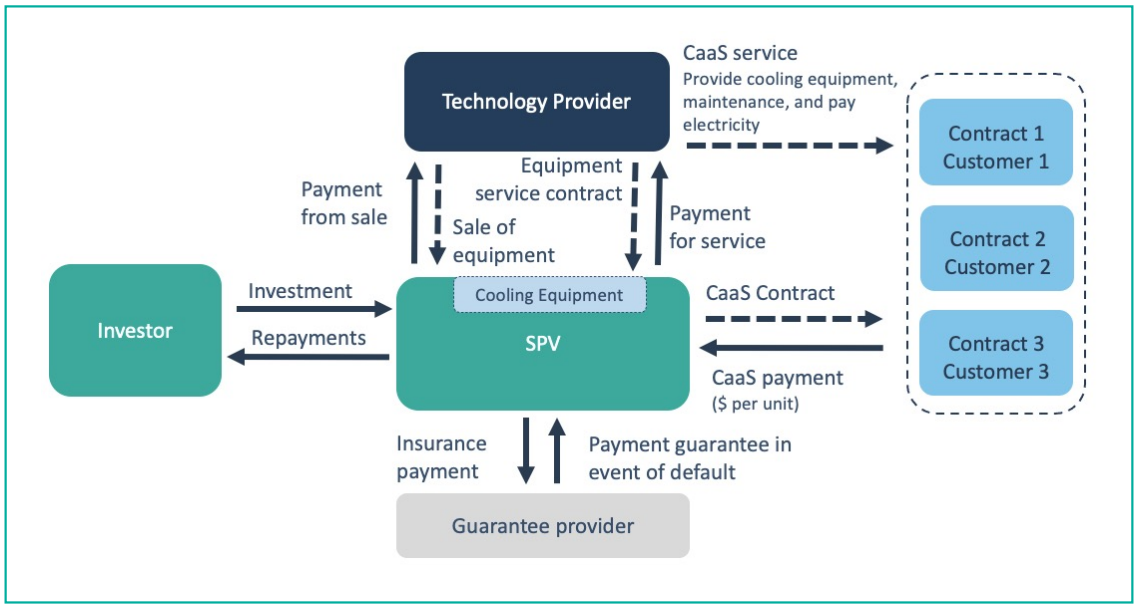


Figure 4: Special purpose vehicle structure

In addition to the operation modification detailed above, implementing Cooling as a Service also comes with a different set of risks for the solution provider and the financier which need to be properly evaluated.

7. Key contractual risks

In this section, we cover some of the key risks related to CaaS and how they can be mitigated.

Payment risk

One of the key risks to which CaaS providers are exposed is the risk of delayed payments or even defaults from customers. This is a risk that manufacturers and contractors do not face in the usual transactional business model, as payments are accrued earlier in the transaction. This risk can be mitigated in several manners:

- CaaS providers are encouraged to conduct proper due diligence of the customers they intend to offer CaaS to.
- It is recommended to start offering CaaS to customers with whom a long-term and trustworthy relation already exists.
- Payment risk mitigation mechanisms exist in some countries which may be applicable to CaaS projects.
- Creating a diversified portfolio will help to mitigate the overall impact of a customer payment risk.
- Developing a modular fleet of cooling systems that are easy to move from one site to another reduces the damage when a customer fails to pay, since the system can easily be recuperated and repurposed.
- Using IoT technology enabling the remote control of the service and the potential reduction or interruption of the service in the case of delayed payment or default can help to unlock the payments.

Technical risks

Since the provider maintains ownership of the equipment and is only paid when the service is delivered, this exposes the provider to all the risks which may occur and disrupt the delivery of the service. To minimise this risk, the use of IoT technology to closely monitor the systems and their consumption is key. Providers then shift from reactive maintenance to preventive/predictive maintenance, enabling a better delivery of the service with minimum disruptions. An additional risk is also the scenario of reduced performance with product degradation. This risk does not impact the user directly but will make the asset more expensive to operate for the provider. To counter this risk, the provider needs to implement reliable data measurement systems to plan a maintenance and upgrade schedule which drives efficiency for the provider, with every investment decision being backed with business value.

Low-consumption-of-service risk

This risk can be contractually and operationally controlled with:

- **A diversified portfolio:** As with the payment risk, a diversified customer portfolio ensures that there are clients with different levels of consumption, depending on different variables (dependent on the industry the end user is active in, the local temperatures and humidity, the size of the project etc). This ensures that there is overall stable consumption across the portfolio of customers.
- **Data monitoring:** Enabling reliable smart metering is key to better understanding customers' needs and adapting equipment design (see "Modular systems" bullet below) or contracts accordingly as the CaaS portfolio of a provider grows.
- **Fixed or minimum fee:** Depending on the client profile, operations and size of equipment, a minimum fee can be requested from the clients so that the provider has a minimum income for the delivery of the service. This is combined with a variable fee based on consumption of the service. Alternatively, in some cases a fixed consumption fee can also be requested, as can a sliding scale of the variable fee charged to the client, which reduces the consumption fee when customer consumption increases above a certain threshold, so as not to overly penalise the client.
- **Modular systems:** As with payment risks, a modular system enables the solution provider to repurpose unused equipment from the client and place it in locations where it is needed and thus provide revenue streams to the provider.

Other commercial risks

When starting to implement CaaS, a provider needs to consider all their existing commercial partnerships on the ground. For instance, should they be using third parties for inspection and maintenance, these should be evaluated in the implementation strategy so as not to damage existing commercial partnerships.

Electricity-price-fluctuation risk

The CaaS provider, who pays the utility bills for the cooling, should be protected from fluctuations in the electricity price. Indeed, while CaaS providers are responsible for the performance of the system, they should not bear the risk of increase in electricity prices nor benefit from a decrease in electricity prices. A solution for this is to index a portion of the price per unit of cooling to the current electricity price, based on a pre-agreed electricity tier.

A more detailed list of the risks can be viewed in the study released in collaboration with the Global Innovation Lab for Climate Finance.

8. Getting started with CaaS

There is no "one size fits all" method to implement Cooling as a Service. It often takes time and iterations of the operations of the solution provider, its products and how their clients are approached. However, below are common factors which we have noticed often apply:

Customer profiles:

Customers that are used to service businesses (such as those in hotels, logistic businesses, retail and real estate) and those that are environmentally sensitive or active in reaching their emission targets and further improving their businesses are strong candidates to apply CaaS. Implementing CaaS enables clients to instantaneously gain access to higher energy efficiency and cleaner systems without the upfront investment. In some countries where subsidies are handed out for decarbonisation, these could even be agreed to be shared between the solution provider and the customer. Note, however, that the model is designed to deliver value without the need for subsidies.

Early adopters:

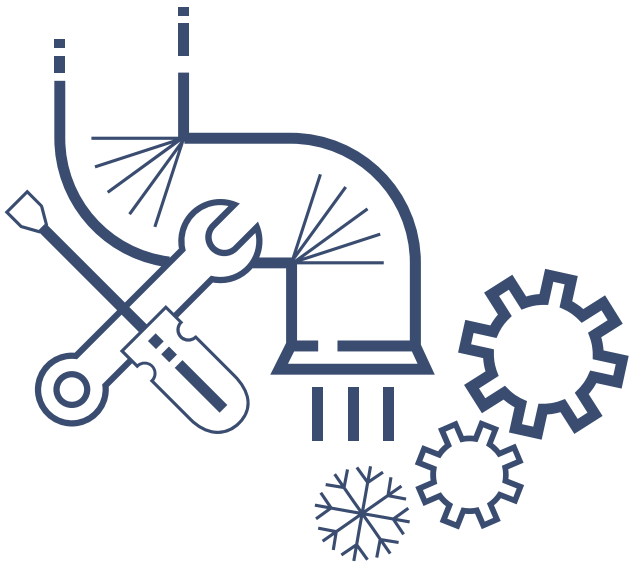
These are innovative leaders and managers who will best understand the value of a business model like CaaS. While some buildings or businesses might significantly benefit from the savings delivered by the CaaS model, the early adopters will be those owned, managed and operated by forward-thinking people.

Customer management:

Management that is innovation curious is highly likely to adopt CaaS. In identifying the right individual (possibly the chief sustainability officer (CSO), the chief financial officer (CFO) or the executive director), it is key to have a "champion" within the organisation who drives the entity to change operations and engage in procuring a CaaS solution from a provider. Note that the person to reach out to is not necessarily the same one that service providers are used to connect with (i.e., typically not the technical manager).

Urgency:

Some clients with well-established businesses are either under pressure to reach their carbon emission targets or are eager to bring savings into the business. This is either due to a shift in market needs, which require that management have extra cash to invest into their core business, or due to extreme events, such as a global pandemic, which can bring businesses to a halt while the need to use cooling remains uninterrupted. The latter is especially painful for a customer when the cooling used on-site is not energy efficient, and they are operating in a region where electricity prices and humidity are high, and the core business stores or uses expensive assets which are highly fragile to temperature fluctuations and humidity. As noted by Jigar Shah (co-founder, ex-CEO of SunEdison, and director at the Biden administration's Department of Energy) at the global CaaS E-Summit, such customers in urgent need to upgrade but without available CAPEX budgets are strong early adopters of a servitisation offering. This may apply to airports, libraries, universities, museums, hotels, hospitals, data centres and others. Jigar Shah's comments can be viewed here.



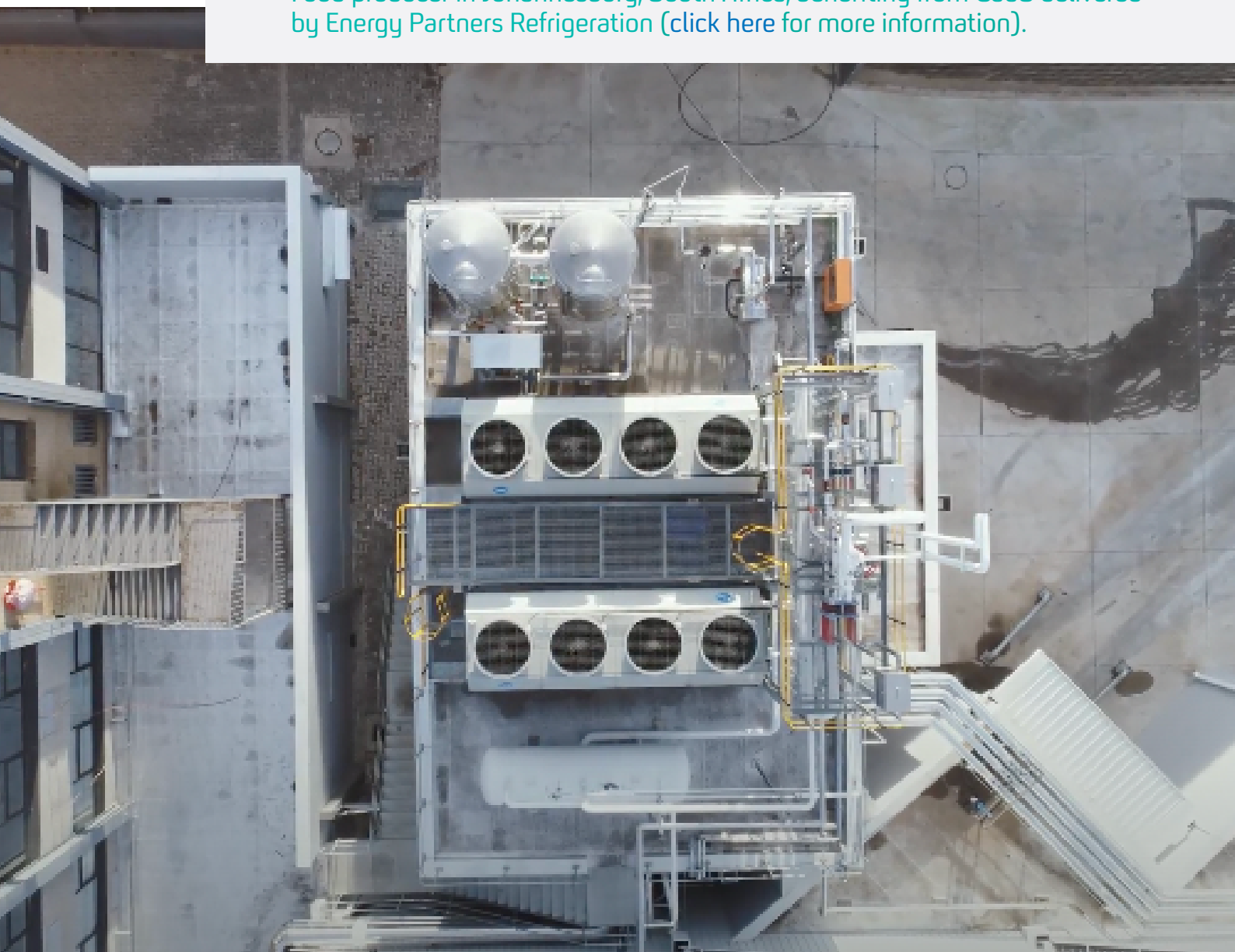
Financial partner:

The right financial partner must be willing to provide an affordable cost of capital and an investment structure which provides enough flexibility to the provider to scale CaaS operations and offer their services at a competitive rate to the end user. Even more beneficial is if the financial provider itself has an existing relationship with the end customer (for example, sometimes banks' account executives have a direct relationship with the CFO or CSO of an entity interested in CaaS). Such relationships enable financiers to clearly see how CaaS can help their clients achieve their ESG goals while increasing the amount of cash available to further benefit and scale their core business. As a financial entity, enabling the financing of innovative business models such as CaaS, is also an opportunity for financiers to differentiate themselves from competition towards their customers.

Learn from others' experience:

Several entities have already implemented the CaaS model in a variety of applications. Many of them shared their experiences at the Global CaaS E-Summit in December 2020, content of which is available until December 2021 on the www.caas-initiative.org website. The website also includes an implementation toolkit including a standardised CaaS offtake agreement, a pricing model and explanatory material for potential adopters to better understand the service. Companies interested in implementing the CaaS model are encouraged to join the CaaS Alliance hosted under the global Servitisation for Energy Transition (SET) Alliance to facilitate the exchange of lessons learnt and participate in accelerating the momentum around the business model.

Food producer in Johannesburg, South Africa, benefiting from CaaS delivered by Energy Partners Refrigeration (click here for more information).



9. Conclusion

Cooling represents the backbone of many industries, and it has become a survival necessity for several regions. As demand grows across the world and is set to triple by 2050, implementing clean and efficient cooling is key to avoiding a climate catastrophe and a surge in demand from the electrical grid.

Servitisation as applied to cooling, called Cooling as a Service, is an innovative business model which shifts the traditional asset-sale mindset to a pay-per-use service model. From industrial cooling to cold storage for agriculture or vaccine storage, CaaS has been proven to facilitate an accelerated deployment of clean and efficient cooling solutions, even in regions and industries facing financial challenges.

Since 2019, the Cooling as a Service Initiative, led by the Basel Agency for Sustainable Energy, has worked on key pillars to support the market in adopting the model. Through this journey, the CaaS Initiative has accumulated key lessons, which have been summarised within this paper. These include the tools required to implement the model, the challenges faced by the solution provider, the risks to consider and the benefits that this brings to all stakeholders involved.

By shifting the ownership of the equipment from the customer to the provider, the model incentivises the latter to keep innovating, deploying increased energy efficiency and modular designs and limiting the amount of stranded assets – repurposing them when needed to increase their utilisation rate, but also recycling them at their end of life or remarketing them. This all strongly incentivises a circular economy. Bringing forward a model which increases companies' revenues by increasing utilisation rates per unit instead of increasing the assets themselves is key to minimising our dependence and use of raw materials and breaking the cycle of an economic model which brings a linear approach instead of a circular one.

While there are challenges related to the shift from a transaction model to a subscription model in the cooling industry, those market players who have invested the time and energy to implement the model are already reaping the benefits of their efforts. They are enjoying increased customer satisfaction, long-term strategic partnerships with customers, higher demand for the latest technologies and increased and predictable revenue streams.

Cooling as a Service is set to revolutionise how cooling is delivered to people. Similarly to how PPAs changed the solar market, CaaS is accelerating across regions and industries, enabling customers to gain access to clean and energy-efficient cooling in a sustainable manner that benefits people, businesses and the planet.

Cooling is only one element of the scope of servitisation. The model is currently being applied in heating, lighting and other systems at an accelerated pace. The CaaS Alliance, today with more than 65 members, is growing into the global SET Alliance which will continue the work of the CaaS Initiative in supporting the market in adopting the model of servitisation in cooling and beyond in a sustainable, circular and accelerated manner.

CaaS

www.caas-initiative.org

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Elisabethenstrasse 22
4051 Basel, Switzerland
P. +41 61 274 04 80
F. +41 61 271 10 10
www.energy-base.org

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