

5 to 8 Minutes Introduction

- Collection of information about the interviewee (educational and technical background, field of professional experiences, professional years of experience, involvement in different types of projects).
- Brief introduction about the interview.

Interviewer

Now let us move to the opening questions. So [Name of interviewee 2], according to your experience, what is your opinion about the current level of knowledge in the building industry regarding the application of multifunctional facade components integrating solar cooling technologies?

Interviewee 2

It could be improved a lot.

It's not really that widespread yet, although there are many motivations for it at the moment and I think more and more project planners are looking for alternative solutions and to integrate more innovative technologies in their plans and designs.

Interviewer

OK. What type of motivations do you think that are associated with the application of such facade systems integrating solar cooling technologies? What are the motivation in your perception?

Interviewee 2

From my experience, the highly increasing prices of energy, whether it is for heating or for cooling, or for electricity in general.

Yeah, they are looking for alternatives to the....what is usually used in the market.

Interviewer

I see. OK, now we have motivations. So what are the your concern regarding the application of multifunctional facades integrating solar cooling technologies?

Interviewee 2

First of all, there is still a huge difference in in the investment cost in comparison to the normal way for the facade. Still it's...the technology is available on the market are not really competitive with the increasing energy prices, but this might change in the in the future.

Interviewer

OK.

Interviewee 2

And secondly, we have the new buildings and we have renovations and in renovations it's really difficult to change that especially in a country where...in Germany where regulations are really difficult to change anything in the building or add something to the design....we've had lots of troubles in this area before.

Interviewer

OK, but so regarding the competitive that might be changed. So what are the potential issues to be considered for such aspects...you say that about the competitiveness is a problem between solar

cooling and the current technologies or conventional methods. So what are the way that can help to address such issues related to the competitiveness?

Interviewee 2

Short term solutions...could involve a government incentives. Here in Germany we have several programs for that. Yeah, there's a good program for solar cooling applications.

On the long run...right now we only have a handful of suppliers for such systems, especially when with the sorption cooling machines, whether it's optional or absorption, there are only a few suppliers in the world, so the mass production of such systems will help reduce the cost in the future and make the technology more widespread.

Interviewer

So mass production involved we have multi suppliers?

Interviewee 2

Yes, with a huge production volume.

Interviewer

Great. So but so now regarding the renovation, you feel that's really difficult compared to new building constructions. So new building construction, the application of such technologies or concepts is as much easier than renovation projects?

Interviewee 2

Of course, of course it's much easier.

Interviewer

OK we talked about the potential incentives. We talked about the new building is somehow easier than renovation projects. But how do you see the effect of different types of buildings such as office residential, healthcare on the application of such facade concepts?

Interviewee 2

There is not really a huge difference at the end. What differs is who is the client, not what kind of building it is, weather the client is looking to make profit, weather the client is looking for something reliable, like governmental entity for example. It is about the goal of the client in such projects.

With governmental projects we see that they want something environmentally friendly, reliable for the future, regardless of the investment cost, more or less. But with private companies it's something different and especially in residential projects where the clients are looking to reduce their electricity bill mainly.

Interviewer

So usually the clients of public sectors are more attracted to such concepts compared to the private clients/

Interviewee 2

Yes. Yes.

Interviewer

OK, I see. But what about...How different building locations and the climate conditions affect the performance of such facade concepts?

Interviewee 2

Of course the needs for cooling is different around the world and also the availability of solar radiation is also different around the world. I think there are....Yeah it's a big difference when we compare for example a country in the Middle East with a country in northern Europe for the need for such applications.

Interviewer

OK, So what are the recommended locations on the climate conditions for applying facade product integrating solar cooling technologies?

Interviewee 2

I think areas where cooling is required more than six months to a year, Starting from southern Europe to.....yeah to southern Africa or almost.

Interviewer

So OK, so let me move to...instead of talking about the locations... we have talked about different type of buildings, and about the different type of projects. So now let me move to more deep to the type of technologies. Can you tell me how different types of solar technologies such as electrically driven (photovoltaics) or thermally driven (solar thermal collectors) can affect the application of solar cooling integrated facades?

Interviewee 2

First of all, there they are complete different ways and technologies that, the electrically driven and the thermal driven.

Each one has its limitations and advantages.

In the end, in each project based on the available space on the location, it can be either the photovoltaic or the solar thermal. So yeah, they are really different kind of technologies to compare.

Interviewer

OK, but what about...What type of limitations for example that varies from an technology to another?

Interviewee 2

Yeah, the biggest limitation is the available area and orientation of the building.

We know that the photovoltaic have an efficiency of around, depending on the product of course, up to 15% or more or less, while solar thermal can reach 80% or higher depending on the type of collector and quality and so on. And then we have to consider the efficiency of the cooling devices themselves. We know that the compressors...Yeah they have a COP (electrical COP) of around three to four while the absorption or adsorption cooling vary between 0.7, 0.6 up to 1.2.

So really, which Collector gets you the most energy will be the most suitable for that project and we usually advise our clients project based. It is a project we sell them. OK our product is suitable for you and others we say no, you can go to the photovoltaic one and also with smaller capacity projects. For example in residential buildings or smaller apartments or so on, photovoltaic might make more sense because so absorption cooling technologies are larger, and suited more for larger buildings. So you need a small two story building to start using absorption cooling, while for a small apartment or for a small house, it's really you will not find a product that will suit you. It's mostly Photovoltaic and compression cooling.

Interviewer

I got it the advantage and limitations. Now let me move to the key questions. So we out covered many aspects in the opening question. So now I'll move to the key question. I'll talk about questions related to technical and product related aspects. So can you please tell me what are the potential solutions that can address challenges related to the product complexity of solar cooling integrated facades, such as they required space availability or interrupting other building services?

Interviewee 2

Yeah, we as a product supplier, we are trying to ease the operation and the planning of such systems as much as possible to the stakeholders. We are working to improve our products all the time to make them more easily applied and closer to the conventional cooling methods.

The space availability is something that is really difficult to solve. We try with the most possible creative ideas, but it's always limited and especially with renovation projects. Yeah, you can install something on the external walls of the buildings. You can use the parking lot, for example. You can we've tried everything, but it's always there is a limit at the end. So what we do with our systems, we usually design the solar cooling in a way to cover a base load. And when we integrate it with a conventional unit that covers the peak load, so it's a kind of a hybrid solutions based on the available area. For such a system.

Interviewer

OK, I see. But can you please elaborate more about how you make it easy for the client to be operated and what way you make it easy to be operated?

Interviewee 2

We have a very simple interface at the moment where the client can adjust the parameters of the system simply with their phone or tablet.

It's yeah, very basic buttons and functions to make it as easy as a normal air conditioner that you put in the room. And yeah, you can integrate it with your smart home system and to cool your building or whatever cooling application you have.

Interviewer

OK, I see.

So OK we have this good application that the end user can use, so this is during the usage period. So in your opinion, what are the most important issues needed to be considered for the maintenance and durability of solar cooling integrated facades?

Interviewee 2

Yeah. When we talk about solar cooling, we have two parts, the collectors, the solar collectors, whether they are photovoltaic or thermal, and we have the cooling system.

Of course, yeah. The maintenance required for the photovoltaic and the compression system usually is more time consuming and should be done more regularly, especially for the compression cooling system. It has to be maintained at least once a year with the re-fuelling of the cooling agent, the Freon and these gases and then you have the absorption cooling for example where you only have to maintain it once every two years. But for the solar technologies it's really different for each type of collectors and for each supplier we have collectors that have to be regularly cleaned and maintained.

And we have collectors that only every couple of years have to be touched. Also, it depends on the location you have locations where there are lots of sand in the air and that has to be cleaned regularly. This is a big issue for Arabic countries for solar, solar technologies in general. The cleaning of the collectors is really expensive and time consuming.

Interviewer

OK, OK. I see.

So let me move to the aesthetic point of view. We have talked already about the maintenance and durability. How do you see the role of aesthetics in the widespread application of solar cooling integrated façades?

Interviewee 2

It's also very important, especially depending on the client. We are working a lot in the UAE and it's really something very important there.

Yeah, we have installed a project simply to make the building look nicer. There wasn't any other advantage of the project, they had a big roof and they wanted to cover it with something that looks good and it's also environmentally friendly and reduce the electricity bill, but the main reason for the project was the looks of the building.

Interviewer

I see. Let me move to the financial aspects.

So can you tell me what are the main issues needed to be considered to develop affordable and financially feasible facade products integrating such technologies in the construction market?

Interviewee 2

I mentioned this before. Mass production will change that drastically, but this is also coupled with the marketing and then the need for such projects with the, with the awareness of the clients of such projects and such systems.

Interviewer

So I have a question about what are the potential financial incentives that support the widespread application. You mentioned the governmental incentives. Are there any other types of incentives you think about?

Interviewee 2

There are....have banks that also can help with such projects. We have also the contractor method where someone offers cooling at a service. Cooling and heating is also a solution for the high investment cost.

Interviewer

OK, I see.

So have governmental...banks.

Yeah, I see. OK, now I'll move to the third part. I have questions about the stakeholder and process related aspects. So we have uh, we have different stakeholders in the facade design and construction as you can see from this chart. So in your opinion who could be the main potential supporters to the application of solar cooling integrated facades?

Interviewee 2

It's actually.

All four of client or end user, investor, architect, consultant and general contractor. If these have the knowledge and know how in such systems then they can be the biggest drive for such an application.

Interviewer

So do you have something in mind? What type of knowledge that should be there in these people? Do you think so?

Interviewee 2

The advantages of such system? They should have it in mind from the beginning phase of the planning of the project that such solution will be useful for the future of the building.

Interviewer

OK, I see.

Interviewee 2

Yeah, we try as a supplier to have. Yeah, regular meetings with such key stakeholders to inform them about our products. We try to have advertisement on different platforms that are relevant for these stakeholders. But of course it will take time.

Interviewer

OK, so I have a question close to that maybe in a different way. So how to increase the technical knowledge and experience of architects or engineers about technical aspects related to the facade integration of such technologies?

Interviewee 2

Yeah, the availability of, for example, online training for such systems, which we also usually offer, but this is also coupled with good marketing for such systems.

Interviewer

OK, I see. So online training, what are the things that are usually should be trained for those people? should be trained and such training.

Interviewee 2

They should know the properties for such cooling systems, how to consider the design that for example, the machines have to be put in a technical room. You need that much space of or that much area of collectors to generate that much cooling. This is very important. Also the orientation of the building to optimize it to improve the efficiency of such system. Yeah, there are many things that can be trained in this regard.

Interviewer

OK.

So, OK, so training is important. But let me ask a question about not training...but about standards or guidelines. So in your opinion, what are the core elements needed to be included to design standards or guidelines related to the facade integration of solar cooling technologies? What are the core elements should be included in if we'd like to have standards and guidelines for people in the building market? What should be there?

Interviewee 2

There are many things to be considered.

Guidelines can include as I mentioned, the required area of collectors, related to the required cooling capacity.

Also, we have the cooling application inside the building. We have several technologies, whether it is radiant cooling with chilled ceilings, or whether it is conventional air conditioning where the dehumidification is required. So for example, for solar cooling applications, we recommend that we use radiant cooling as the efficiency of the system will improve. But this is of course not always applicable in every area. Some areas required you dehumidification, so air conditioning is required.

Coupling solar cooling with conventional units....which units can be used and which for which capacity is also different topic.

Interviewer

Yeah there are many things I can see that could be considered for such guidelines. OK, great. Now I have a question about you talked about...you talked about the mass production. So I have a question about in what way can the industry increase variety of products.

But OK, do you have the mass production that could minimize the cost, but because sometimes we have different clients, we have different opinions. So and what way the industry can increase the variety of products that would attract customers to apply solar cooling integrated facades?

Interviewee 2

In regard to that, that chiller part (to the cooling machine part), I would say offering the capacities that suit different clients from smaller homes up to big buildings, which we are trying to do. We have lots of machines, capacities ranging from 10 kilowatts to 100 kilowatt. But we are also planning smaller units for smaller homes.

And other than that, in regard to the solar part of the solar collectors, I think the flexibility of such systems to be integrated in the facade of the building is really important, and I think lots of companies now are inventing some new ideas, new innovative ideas to, to ease such installations for the clients.

Interviewer

But overall how do you see the whole picture that we ...how can we improve the future interests of designer developers and the clients about the integration of such technologies? You mentioned already the advantages that should be aware about the advantages about the motivation. Are there some ways that could be considered to improve their interests? The clients, designers and developers?

Interviewee 2

The regulations are driving them towards such technologies slowly but it's increasing with time. We talked about the rising electricity prices. There are also refrigerant regulations that are really being more strict with time and they the general direction to natural refrigerants. So the regulations are actually pushing the those stakeholders to alternative solutions such as solar cooling, but of course, with better marketing, more making the systems more easily to use, and making it easy for the architects or the project planners to plan such systems will definitely help.

Interviewer

OK, got it. So make it easy. Are there some ways, important things that we can make them?...Should be considered that? Or core characteristics that are considered to be important that yeah this characteristic make the product easy for people for clients and architects?

Interviewee 2

Uh, yeah, it's easy as I said, for new developments. The architect has the knowledge to design such a system from the beginning, it should be a big motivation for them to do that.

Interviewer

OK, OK. Now let me move to another thing before moving to the process questions.

How would legal legislations affect the widespread application? So you talk about, I think, already talk about the regulation, about the refrigerants, those things...Are there any other things related to the legal legislations that can affect the widespread application of solar cooling integrated facades?

Interviewee 2

Incentives and taxing the conventional environmentally unfriendly technologies.

Also a bit more flexibility in the changing of the existing buildings.

Lots of regulations prohibit the change in the external walls of buildings inside the city, for example.

Uh, yeah. So more flexibility would help.

Interviewer

OK, I see.

Now let me move to the last part before the closing question. So we have different processes of facade products. We have the design phase, we have the production phase, we have the assembly

operation and end of life. So in your opinion, do you think there are particular phases that are considered to be the most important ones?

Interviewee 2

Most important in what way?

Interviewer

Generally that are considered to be more important than the other or are critical than the others?

Interviewee 2

If we are talking about choosing the system, then it has to be the design phase that from the beginning of the building has to be planned accordingly that we are using solar cooling, but after that the design phase is set and such a system is chosen I think...yeah....all phases are as important as the rest. You know you. Yeah, there isn't really a difference.

Interviewer

So in the design it should be considered in the early phases to know how...so core issues to be considered in the design is to know which system to choose.

Interviewee 2

Exactly

Interviewer

OK.

Interviewee 2

The rest is all doable with whatever it is.

Interviewer

But I have a question...during the design, do you think how can we achieve a closer collaboration among various stakeholders and disciplines during early design stages? How we can achieve closer collaboration?

Interviewee 2

I'm not really sure I understand that the question...in first planning stages...it's usually the client and the project planner.

Then other companies get involved...the facade installer and so on that the project implementation. So there has to be a good collaboration between the end client and the project planner and one of them has to have the drive for such a system to be installed.

Interviewer

OK.

Interviewee 2

This is the first stage I think, and I think also the manufacturers or the specialized companies, such technologies can give important input at the beginning at the planning stages of the project.

Interviewer

Umm other do you have something in mind about important issues needed be considered in the production phase?

Interviewee 2

In the production phase.

Interviewer

Yes.

Interviewee 2

Yeah. In some projects there are limitations that can be addressed with a customized solutions and their production. For example, we have, we might have a building with a technical room that is really low in size. So we have to do a customized product that will be lower than the usual one. This is something that is done project based, but other than that, we have a standard product portfolio, so not really a manufacturing is not really affecting the project. It's the same machine for each project.

Interviewer

OK. Do you have something in mind that important issues needed to be considered for the assembly phase for integrating solar cooling into facades?

Interviewee 2

The assembly phase, of course it has to be a specialized company. It's not really more complex than plumbing normal HVAC. So it's not really that that difficult in comparison to other systems.

Interviewer

HPAC?

Interviewee 2

It's heating...HVAC.

Interviewer

Yeah HVAC OK....got it....OK HVAC.

Operation phase I think you told me there are things related to for example you talked about the cleaning those things you talk about for example one way is that we have the interface or application that can be considered by the end user....and do you have something in mind for the end of life of the product?

Interviewee 2

The end of life...yeah, that has to be in accordance with the regulations at the locations like, especially for the photovoltaic. I think they have really strict end of life regulations. But for example, for our technologies we have a solid material and naturally correct material. So we estimate a life cycle over at least 20 years for self for our machines.

Interviewer

But what type of regulations in the photovoltaic that are existing?

Interviewee 2

I think they have to be replaced after a while and they cannot be, yeah, replace that that easily you have to give them to the appropriate waste management facilities and then you have to install the new ones, yeah.

Interviewer

I see.

OK, I got it. OK so the end of life, I can see that there are different issues need to be considered if it's photovoltaics or solar thermal.

Interviewee 2

Exactly and also you have to consider that for example in the solar cooling, whether it is.

photovoltaic with compression, you know that the compression chiller will need replacement or has a has a low shorter life than the photovoltaic, so it has to be replaced accordingly. The same with thermal collectors and absorption. For example, the thermal collectors have to be replaced earlier and they have to be replaced with a system that also suits that installed design of the absorption chiller.

Interviewer

OK, I see.

Yeah, actually I got your point basically. I now I just covered all the questions. Now in that I have just few questions that are in the closed question.

First of all, what are your final remarks about supporting the widespread application of solar cooling integrated facades as building products in the construction market?

Interviewee 2

Yeah. As I said earlier, I think the situation and the fluctuations in the energy prices are really driving for alternative solutions. This is one of the most viable solutions for this issue. And I think with time, this technology will be much more widespread, especially in regions where cooling is required all the time where cooling is more than 70% of the required energies for cooling.

So yeah, with time it will work. More marketing effort will be needed from different stakeholders, but this is being done and hopefully one day. Yeah, it will be as an easily accessible product and a very widespread product.

Interviewer

I see. OK. Got it. So now actually like the good thing I'm done with almost all the questions and we still have 12 minutes. So just a final define a question, do you mind to propose potential participants that can be interviewed for this study?

Interviewee 2

I don't know who you have interviewed already...but I would recommend someone for example from [...]....there's solar thermal collector manufacturer here in Germany.....