

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

So now I'll move to the opening questions. So [Name of Interviewee 16], first of all, can you tell me in your experience, what is the current level of knowledge in the building industry regarding the application of multifunctional facade components integrating solar cooling technologies?

Interviewee 16

In the Netherlands, I would say medium....It's not....well, it's not high. We don't have all the knowledge, I think. Especially countries like Germany or Switzerland are way ahead of us in like integrating in their buildings. I think in the Netherlands we rely more on the standardized off-the-shelf, like the PV on the roof and heat pump in house and that's it.

Interviewer

OK, so now I'll move to the following question. In your experience, what are the motivating factors for the application of multifunctional facade components integrating solar cooling technologies?

Interviewee 16

In the Netherlands, I think that's money. We tend to spend....well as little amounts of money as possible on a building. Germany, the budgets are way, way higher, especially for public buildings.....and also the, well, the guy who gives you the money, or woman, the clients.....if he doesn't care....if he just wants a building and he wants it done as cheap as possible.....well, he's got a pretty strong say in it.

Interviewer

So yeah but what you are answering.....is it the motivations or concerns?

Interviewee 16

Well motivating factors for the application of the.....yeah, motivators.....Yeah. Money it....It has to....In the in the Netherlands, at least, it has to be cheap to have to be applied.

Interviewer

OK.....So now what are your concerns regarding the application of multifunctional facade components integrating solar cooling technologies?

Interviewee 16

I think the main one might be lifespan.....Well technology for the last 50 years, it has evolved so much.....and for example, when we design a building, it's for 40 or 50 years to stand up right....I think the lifespan of the technology you put in the building is normally shorter, and that's also if you make a full, well, multifunctional façade, it might not outlast the building.

Interviewer

So how we can deal with such concerns?

Interviewee 16

Well, figure out a way to make it last as long and be efficient for all that time. If you put solar PV on the roof...the PV panels will last 20 to 25 years.....the....what's it called the transformer thing....has a lifespan of about 10 years, and then you need to renew it.....So we....yeah....I think research into, yeah, expanding lifespan is...we have to do that.

Interviewer

OK. I'll move to the following question. How can the type of project, such as the new building construction or renovation projects, influences the applicability of solar cooling integrated facades?

Interviewee 16

Well, with the new building, you have a lot more form freedom to do what you want, and simplest and easiest ways to face the building South. So you have more façade area for your PV, for example. Facing the other way so you don't have high solar gain, solar loads.....But, well, we have a massive building supply yet which can be renovated, so I think most of the efforts is going to go into that subject, and then you have an existing form, an existing structure, which you then need to upgrade....Yeah, then you have, well, less design options...So, well, yeah that influences the applicability, yeah.

Interviewer

Yeah, got it. So now I'll move to the following question. So we talked about the type of project. So now I'll talk about the type of building. So how can the building type such as office, residential, healthcare, educational or other type of buildings, influences the applicability of such facade products?

Interviewee 16

Well I think that's...The type of building is really important. If you do housing, you have small, maybe not that small...but apartments....and every house has another use case....If you do an office, you have 9 to 5.....you don't have a 24 hour energy use....If you do, for example, hospital, you can maybe do a lot more repetition in the in the façade..... A problem now with housing, for example, if you do solar PV, you got a massive electrical gain at 1, 2, 3 in the afternoon when the sun is high, and then at 7:00 PM when everybody's coming home, they put on the laundry and charge their cars, and then you have a massive drain. So you got a big mismatch of energy demands and production....So I think, yeah, office buildings, residential, healthcare and....I think the scale is good in that in that sense you can make a big building you have a nice uniform façade and you can place a standard products all along the facade.....Yeah, uniformity, lots of products bring the price down, I think that's easy.

Interviewer

Got it. So now I'll move to the following question. So in your experience, how do the locations and the climate conditions of buildings affect the performance of facade products integrating solar cooling technologies?

Interviewee 16

Well, I think the effects are quite high, especially how further up you go....If you go into the Nordic Scandinavia, you got all worse climates....well worse climates....it's colder....you get less sun....As opposed to more to the equator where you have lots of sunlight, and the only thing, you have to do is add more insulation, more mass to keep it cool.

Interviewer

So generally which locations and the climate conditions would you suggest to apply such facade products?

Interviewee 16

I think Europe, the US and Asia....Yeah what kind of climates....are the moderates climates....not the extremes....Yeah, I think.

Interviewer

OK, now I'll move to the following question, so do you think the choice of solar cooling technology, namely electrically driven or thermally driven, would affect the application of such facade products in a particular project?

Interviewee 16

I think a closed system is preferable. If you have like interchangeable units that, I think, that should work the best. If you integrate it with the building, I think we have to go to the solution where you can see the facade as a whole and if one unit malfunctions, you can take the unit out and replace it with a new units. For example, now climate systems are so massive and incorporated in the building. You need specially trained people to go into the building. Step on the ladder and fix something. I think the easiest way is to take out the elements and fix it off-site, where you have more equipment and then bring it bring it back.

Interviewer

So now [Name of Interviewee 16], I'm done with all of the opening questions. I'll move to the key questions. So the key questions will cover three main aspects, technical and product related aspects, then financial aspects, and then finally process and stakeholder related aspects. So now I'll start with the first one. Questions about technical and product related aspects. So in your opinion, what makes solar cooling integrated facades complex products?

Interviewee 16

So it's a technical solution for....You're building a machine to, for example, guard you from the heat. In the most simple way, if you need shade, you build an umbrella or a solar shield, and now you going to absorb all heats, converted to something else, and then send it further.

Interviewer

Do you have something in mind that we can address such complexities.

Interviewee 16

Keep it simple.

Interviewer

Yeah, OK, now I'll move to the following question. So how we can address challenges related to the space availability or interrupting other building services we when we integrate such technologies into building facades?

Interviewee 16

Well, yeah, make it like as I was explaining a bit earlier....maybe like integrated facade elements....If you work in an office and the AC is not working, you don't want people on ladders running around in your office to fix it if the system is in integrated....and maybe on the outside of the of the building you can take one part out and replace it with a new.....like if you could take out a Lego and replace it with the new one.....you have less downtime and interference with the with the users of the building.

Interviewer

OK, so now I'll go to the following question. So [Name of Interviewee 16], what are the key aspects to consider for the maintenance and the durability of solar cooling integrated facades?

Interviewee 16

Oh yeah....the interchangeable units and also the a operability. We have all kind of shortage on educated mechanics. I think that's only gonna get worse if we do a lot more technology driven solutions for buildings and for housing.

Interviewer

OK, now I'll move to the following question. So how do you see the role of aesthetics in the widespread application of building facades integrating solar technologies?

Interviewee 16

Yeah I'm afraid that's rather high. I said earlier that when we design buildings, we design buildings to last for 50 years. You want the technology to last for 50 years as well. But also the.....Well the view and aesthetic of the building.....if it's already outdated after 10 years, technology wise or aesthetic wise, people don't want to live in it and companies don't want to rent out offices there. So I think that's the important part.

Interviewer

So generally, what are the key aspects that should be considered for the aesthetics when we design façade products integrating such technologies? What are the key aspects that should be considered?

Interviewee 16

Yeah, I think adaptability in the façade....if the only option is to make a massive element which is 3 meters wide and four meters high, and we have to repeat that every time....You want, I think, a rather small element like maybe the size of a window which you can repeat every other apartment, for example. Like the adjustability and the compactness.

Interviewer

Now I'll move to the following questions. I have two questions about the other category, which is the financial aspects. So now I'll move to the questions about financial aspects. So in your experience,

how can the industry develop affordable and financially feasible facade products integrating such technologies?

Interviewee 16

By massively upscaling the process....You need small, repeatable, interchangeable units....Like mass production of small elements....kind of like what the AC did.

Interviewer

OK, now I'll move to the following question. What are the potential financial incentives that can support the widespread application of solar cooling integrated facades?

Interviewee 16

I think a fee like a as CO2 equivalents tax. You pay what you use. If you do bad for the environment, you pay more. If you use more electricity you pay more.

Interviewer

Got it. OK so now I'll move to the last category of questions. So I have questions about process and stakeholder related aspects. So here, as you can see from this chart, we have different stakeholders involved in the facade design and construction industry. So now the question is, in your experience, which of these stakeholders can support the application of solar cooling integrated facades?

Interviewee 16

I think you have to combine the architects and clients. They have to group together. The architect has to convince the clients or user or investor to make a nice energy efficient comfortable building....and then the architect has to go to facade builder....and whilst designing the building, keeping in a very close contact with the facade builder to design an actual integrated design. The consultants are on the side on this a bit.....And when you have a preliminary design finished, I think it's time to move in a general contractor to work things out further in order to build a building.

Interviewer

So now I'll move to the following question. So how can we increase the knowledge and experience of architects or engineers regarding the technical aspects of integrating such technologies into building facades?

Interviewee 16

Yeah by making standards products. I think the problem we have now is that it's all well-special made for you.....The architect has to go to the same design, and every time they come a slightly different product or a slightly different interpretation of the of the product out of it, and there's not like out off-the-shelf product that works for everything. I think that's what we need to go to.

Interviewer

OK so now what are the key elements that should be considered in standards or guidelines for architects and engineers related to the integration of solar cooling technologies into building facades?

Interviewee 16

Well, apart from standard products, I think we also need some key numbers as well as proof of work. Like examples for...hey in this building it worked. The clients are happy. The people in the building are happy.....and also maybe some governments guidelines. For example, we have some guidelines from building code on the amount of insulation you need to put in the façade or on the roof, and now with the bang, also the amount renewable energy you need to produce.....Yeah, maybe in the liberation on governments guidelines, as well.

Interviewer

OK. You mentioned key numbers that should be there in standards or guidelines.....So what key numbers that should be there for architects? What are the key numbers that should be....?

Interviewee 16

Is there like a unit for.....I don't know if you can compress it down to one number.....For example, you have the R value for the amount of installation, but that's not like a number for.....Yeah you have at the bang the amount of kilowatt hours per square meters per year which need to be produced, maybe we can relate it to that one.

Interviewer

OK, got it. So now I'll move to the following question. How can the industry increase the variety of products that would attract customers to apply facade products integrating solar cooling technologies?

Interviewee 16

I think first you have to have like a standard product like the one that's actually proven and works. For example, in the beginning you had the PV façade in Stuttgart in Germany.....I think you need to convince architects more. It's still kind of a far far away show.

Interviewer

So how can we increase the interest of designers, developers and the clients in solar of cooling integrated facades?

Interviewee 16

Well we quite often have here at the architecture firm is, for example, lunch and learns with suppliers or like design meetings, which we do like half hour, hour presentation and then a design sprints to incorporate a product of a certain supplier in, well, in a short design.

Interviewer

OK, so now I'll move to the following question. So how can changes in building regulations affect the widespread application of solar cooling integrated facades?

Interviewee 16

Well, if it's obligated by building regulations, then it must be followed up. So I think that's a strong possibility of moving the whole building industry to right way.

Interviewer

Now what about the changes in energy policies? How can changes in energy policies affect the widespread application of solar cooling integrates facades?

Interviewee 16

Well, kind of the same. If you are not allowed to use more than this amounts per square footage, or per square meter in your building, this amount of energy, then you're gonna think twice before making a fully glazed facade with a high cooling load. So yeah, I think that's.... yeah.

Interviewer

OK, so now I'll move to the questions about processes. So here, as you can see, this chart provides or illustrates the processes of facade products. So we have the processes related to the design phase, then production phase, assembly, operation, and then end of life. So in your experience, which phase is key or important for boosting the integration of solar cooling technologies into building facades?

Interviewee 16

I'm afraid it's quite early on. So like predesign and development phase, and the architectural design. Yeah you can't really....it has to be integrated in the aesthetics of the façade. So you can't make it all the way at the end....during the assembly phase and then the constructor comes up out of the dust and says hey look what I found on the back of trucks....let's slap it on the building when it's almost finished. So yeah, quite early on, like predesign and then architectural design.

Interviewer

OK. Got it. So now I'll move to the following question. So what are the main aspects to consider during the design phase of building facades integrating solar cooling technologies?

Interviewee 16

Well, the adaptability to make it into the façade.....also if more the size and the scalability, maybe. If you want to use it for a singular apartment or a single studio or a full office floor.

Interviewer

OK. So what do you mean by the adaptability?

Interviewee 16

Yep, adaptability in size, maybe if you have 1 unit meter by meter...that's enough for an apartments, but if you want to use the same units on an office floor, you either have to scale it up to five meters by 5 metres, or use ten of the same units right next to each other, and you can link them and you can make them make them drop away, something like that.

Interviewer

OK, got it. So in your opinion, how can we achieve a closer collaboration between various stakeholders and disciplines during early design stages of solar cooling integrated facades?

Interviewee 16

You may need to make the architects aware of your product. So for example, during a trade show, you need to, yeah, advertise your product. Put it out the in the market. Well, make it make it known.

Interviewer

Now, what are the key aspects to be considered during the production phase of building facades products integrating solar cooling technologies? So now we moved from design to production.

Interviewee 16

Yeah, and....I'm not quite sure....I think the technical difficulties.....well still in my mind, in the back of my head with the 50 year lifespan.....how do you make sure that it's....the product works for 50 years. You can't run a car 50 years continuously without the falling parts. So easy to maintain. Easy to operate.

Interviewer

OK, So what about the key aspects that should be considered during the assembly phase?

Interviewee 16

Yeah either make it like premade off-sites and drive it in on a truck, or really easy to install. As I said earlier, we have quite a lack of trained mechanics. So it really needs to be almost plug and play. Like put it into place. Put on the electricity and be done with it.

Interviewer

So do you mean that the plug and play is one of the key aspects which you should consider for the required workforce?

Interviewee 16

Yeah, as little as instalments on-site as possible. If you do like a.....what's it called....Now for example an AC outside unit, inside unit, you have to make the coupling with all the liquids coming through. It's like a half day work to install one units. I think that's way too long if you have to do 20 on one floor and then you have 20 floors.

Interviewer

OK, I see. So now I'll move to the following question. What are the key aspects to consider for the operation phase of building facade products integrating solar cooling technologies?

Interviewee 16

Make it easy.....preferably you have 99% of errors be fixable by someone with no prior knowledge. So like a IKEA instalment guys saying "hey if this slide is flashing, click that button".

Interviewer

OK. So what about the key aspects we should consider for the end user knowledge?

Interviewee 16

Yeah it has to be simple plus less interaction is better, and I think if you buy a house, if you rent an apartment, well it's kind of interesting when you've got a PV on the roof and then you have the transformer thing....you can see all the numbers.....like hey this time I'm producing this much amount of energy.....but that's I think the most interaction anybody wants with their solar system, with the building integrated systems.

Interviewer

So now the last question before the closing part. What are the key aspects that should be considered for the end of life of solar cooling integrated facades?

Interviewee 16

Well part from...I think the obvious....not contributing to like a huge waste pile.....for it...be circular.....Well nontoxic.....And preferably it can be taken apart, upgraded and make sure it works for another 50 years. So it doesn't have the end of life.

Interviewer

So now [Name of Interviewee 16], I'm done with all of the key questions. So now I have just few points to ask in the closing question. So what are your final remarks about the widespread application of solar cooling, integrated facades as building products in the construction market?

Interviewee 16

Well, first of all, I think you have to look very closely per building per situation per location. Is it necessary to fix a problem with technology instead of.....Yeah, if you have a high sun, what you gonna do....Are you gonna put up an AC or put up a solar screen? Like what's the low-tech solution for the for the problem?

Interviewer

Ok so what do you think about the application of solar cooling integrated facades for enabling energy transition?

Interviewee 16

I think it's an amazing idea.....I mean, technology can save all of our lives, but it also.....Well, we only have limited resources and we can't put an AC in every house just for the sake of it. So I think we have to be very careful in our way of design if we cannot trust solely on technology instead of...like...simple solutions.

Interviewer

Ok now do you mind to propose potential participants to be interviewed for this study?

Interviewee 16

Yeah, I can do that. I can ask around.....