

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'm done with my introduction. [Name of Interviewee 14], so now I'll start with my questions. So Are you ready?

Interviewee 14

I'm ready.

Interviewer

OK, so first of all, [Name of Interviewee 14], 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 14

I would assume from experience that the level of knowledge is rather low. I mean especially depends whom you're talking about. I would assume that most of the architects, they're not really well familiar with these kind of technologies. And probably if you look into MEP planning, they might have a broader knowledge, but even there is something they might know it, but I got the feeling that they're rather afraid, at least from my experience in Germany of diving into these new solutions, although I wouldn't count them as to be really new. But still. And from a facade engineering or contractor or consultancy system on... let's say that...I mean they're probably known, but I wouldn't say that the maturity of experts on the market are really familiar with it. I would say I mean it's really tricky to answer for me because it's might be for me more obvious. But if I think about what I experience in the market and in the projects and also when we present something that we've been working on in this field, the feedback rather seems as if people don't have a broad knowledge about these kind of technologies. I mean, a really common thing is that people can't tell the difference or remember the difference between PV and solar thermal. You know and this is like the basic starting point, and if they can't even differentiate between if it's photovoltaic or solar thermal system, then you can't say that the level of knowledge is quite high. I mean, the interest is high, but I think there's still a big lack of knowledge.

Interviewer

OK so what are your concerns regarding the application of multifunctional facades integrating solar cooling technologies?

Interviewee 14

I would say I personally don't have main concern, but maybe in the in the market it's still a lot of planners or also contractors, they don't have a lot of experience with it.

And I mean especially when you with....I would say the acceptance and the knowledge about photovoltaics is increasing. But I mean, even when you talk about facade design and engineering, then you have at some point a separation of fields between the facade and the electric plan, which is an issue. And then when you start with solar thermal and then even bringing solar cooling systems into the façade, then it becomes even more complex where the facade contractor says "I'm not

doing hydraulic, I'm not doing water, I'm not doing electricity. I'm just installing simply set panels or facade units. But all these technical components that are more MEP driven is not my field of expertise". So I think the problem sometimes is that with a multi-functionality you also get let's say a multi field problem and they need people to work interdisciplinary, which in a lot of real projects is an issue because everyone's kind of staying on their ground and are careful that they do what they're capable of. Also because of warranty reasons. They say "ok this my field of expertise. This I can do and everything out of this. I'm not touching it". Because they don't wanna be responsible.

Interviewer

OK, I see. So in such challenges.....What are the potential ways that we can address such challenges?

Interviewee 14

I mean. Yeah, different ways. So one thing that we always make good experience with....I mean it starts with the planning. If all the planners are interested in collaborating and developing something in a holistic way so that everything works together, and then also clarify clear points of separation and handover. I mean, for example, we had a project which was also continuing and building a demonstrator facade on solar thermal systems in the facade where we didn't use neither a normal flat collector nor heat the vacuum collected but standard heat pipes. And I mean with this the interesting thing is....I mean both of their also used for the vacuum tubes.....but the good thing is that you don't have any hydraulic connections within the facade because it's a closed system. So you rather have like a plug and play approach where for the facade contractor he's not worried that he need to ensure that he needs to do some piping and need to ensure the peace and water tight, which is not his field of expertise. So I mean design with this knowledge in mind that when you fabricate and install it, then need to be a clear and handover and a clear separation. Because otherwise, in you might need at the same point of installation or fabrication, different fields and different people with different expertise and responsibility, which always makes it more complicated and does also more costly, which then is in the end always the reason why it's not being done when it becomes to cost intensive.

Interviewer

So now I'll move to the following question. So we talked about the concerns and how we can address them. So now the motivations. So what are the motivating factors for the application of multifunctional facades components integrating solar cooling technologies?

Interviewee 14

I would say it's probably quite obvious right now, summertime in Europe, that it's getting hotter and hotter. So you need some way of cooling and the reason why it's getting hotter is climate change. So it doesn't make sense to burn coal to cool your buildings. So therefore it makes sense to use renewable energy. So this is probably like a personal or also step-by-step becoming a societal driver for this. But also given the current situation, I think a general motivation in the market is that it's not only requested by clients and users to be, let's say, more sustainable or energy efficient within that building. So produce energy within the building. It makes sense to produce the energy through some for cooling. So when you need to cool get it from the solar radiation. So it's linked to each other and I think, yeah, motivation there is also.....One motivation potentially also building certification, so we experience this more and more that this becomes a driver and then we and also step by step cost. I mean I mentioned it. These kind of solutions may still be more expensive than not doing it, but we see a shift in an investment to operational cost. And you might have higher investment, but

especially if you have a client that is building for himself, they're more and more look into what does this actually mean on operational cost perspective. And if I produce my own energy to cool, this is a high potential to save money in the future.

Interviewer

OK, got it. So now I'll move to the following question. [Name of Interviewee 14], how can the type of the project such as new building construction or renovation projects and influence the applicability of solar cooling integrated facades?

Interviewee 14

I mean in general, I would say, it's always easier if you build new because the refurbishment always comes with a certain challenges and restrictions. And presumably talking about multifunctional and high technology solutions, they potentially need more space and potentially have higher loads than the existing facade you have. So you might just not be able to do it. And I mean the other thing is that talking about types less about whether it's new or refurbishment, but also of the building typology, OK. So general architecture typology but also usage typology I think is something that is quite relevant. I mean looking into typology in hotels or office space, the demand and also the level of realization of cooling as such in general is way higher than for example in the normal housing sector. So in Germany you don't have any normal apartments with cooling, but newly built office spaces they have at least a mechanical ventilation that to a certain extent enables cooling.

Interviewer

OK, I see. So actually you answered two questions in one because the following question I was going to ask you about the building type.....about the office...but you already discussed it. So now I'll I can skip this question. That's good.

Interviewee 14

OK.

Interviewer

So in your experience, how do the locations and the climate conditions of buildings affect the performance of solar cooling integrated facades?

Interviewee 14

I mean the interesting thing is obviously it has a direct performance link. I mean if I build in a location and with an orientation and on the spot where don't have shading, I can just produce more energy, obviously. So the performance would be high, but looking at it from a more holistic view, the question is if I have, let's say less solar radiation on the façade due to the location, I may also need less cooling or less cooler air, which might from another perspective actually make my solar cooling more effective because I don't have to cool as much and also not to such a low temperature. So I mean it's obvious question because the more sun you have, the more energy you produce, but yeah, I would say in the end it's very project specific. The performance.

Interviewer

OK, so generally, which locations and the climate conditions would you suggest to apply façade products integrating solar cooling technologies?

Interviewee 14

I would say if it's only solar cooling....The tricky thing is that for example, I live in Berlin and potentially like 10 years ago, nobody would plan with cooling system. Hesitant. But these couple of days when it's a little bit hotter in Berlin, you don't need cooling....but with nowadays summer climate would say you need cooling, and especially when we talk about office spaces, where nowadays the facades are so good that you actually don't need heating. But in summer time, especially if I have a lot of glazing, you have a problem of summer overheating. So you need cooling. And then I would say I mean you also find really nice PV facades on buildings in northern Sweden. So I wouldn't say if there's one location where I can do it and another location where you can't do it. It's always dependent on the needs of your specific building and the efficiency of the systems you're using and also what you're aiming for with this.

Interviewer

OK. Got it. So now I'll move to the following question. So how do the choice of solar cooling technology such as electrically driven (PV) or thermally driven (solar thermal collectors) would affect the application of such façade products in a particular project?

Interviewee 14

It is a little bit as I mentioned beforehand that the PV due to being an electrical component which is also for facade contractor more common than those hydraulic component. I would say it...Easy speaking, it's easier to integrate because it's probably more accepted and it also comes along with less complications on the way because you don't need a hydraulic system. You don't need to do the pressure testing. You don't need any fluid storage. You also don't need then absorption cooling machine or something. You just have an AC. Just produce electricity and you have an AC. So simply say it's quite straightforward. So I would say...and this also comes back to what I mentioned earlier that a lot of people, if you talk....even you give them a speech half an hour about the solar thermal system and then they ask you about electricity....and what?!....So this is the broad field they see solar energy production as PV and as electricity. So I would say generally it's easier because from a technical standpoint and also from an acceptance standpoint and probably also an understanding and knowledge standpoint, this is easier to go for. But on the other hand side, solar thermal also has its positive sides. I mean we do a lot of solar thermals less for cooling, but rather for heating, and then you have it actually in the intermediate times and winter times, you have the low sun angle on your facade, and then your solar thermal system within the façade so actually have higher gains with the solar system and the time we actually need heat for heating and hot tap water than for cooling. And even for me, from the experience we had also in R&D and in discussions with others in projects and in R&D, it still seems to be way more complex to use thermal energy for cooling than just use electricity. Even experts in the field that I discussed with from [Applied research organization], they're like, well, there is like solar cooling from solar thermal, we're not really following this path anymore. And I mean, they're really into sort of a developing solar thermal systems and that's what we use it for it.

Interviewer

OK. So now I'll move to the key questions. So I'll start with the questions about technical and product related aspects. So since you talked about the complexity, you repeated more than one about the complexity. So in your opinion, what makes solar cooling integrated facades complex products?

Interviewee 14

It's because it's a combination of not only various components, but also various technologies and various fields within building construction. And this is probably the trickiest part that you have a mixture of facade and MEP.

Interviewer

So maybe you mentioned the answer to this but.....how could we address such complexities?

Interviewee 14

yeah, it's as I mentioned before. I did. The first step is to have an interdisciplinary planning and to clarify the points of what the responsibility of each field and I mean in the end it's probably also the related to the question you had before, what's the level of knowledge, where I would say it's probably not yet that high and I mean the more people know about it in like planning or fabrication, installation and so on, they are more open. They are potentially to realize it as well.

Interviewer

OK now I will move to the following question. You mentioned before about something related to the space availability. So how could we address challenges related to this space availability or interrupting other building services?

Interviewee 14

I mean it's always the question depending on how you integrate it in the overall space. I mean what will always be a major issue if you need rentable space. You use a rentable space for these kind of installations, because in the end rentable space is the money made by the investor.

Interviewer

Rentable space?

Interviewee 14

So I mean you can build your building to a certain edge. So you can't build it to wherever you want. But given by building codes and regulations, they say OK, you can build until here and then I have this brown surface, this open plan, and the bigger this plan is, the more money I can make by renting out the space, the square meters. And the more I take away from the square meters by adding up a big facade, a deep façade, This for me a big issue or what I see from investors. So if you say you need more space for the facade and therefore less rentable space, this is of course an issue and I mean when coming back to what we discussed earlier with the refurbishment, the problem is that if you refurbish you may need to go outside of the facade and if the building code says you're only allowed to build to this line, then we just can't do it. So the question would rather be can you get a more integrated solution where you can combine it, make it as small as possible, or you have a raised floor, or you have a false ceiling, kind of able to integrate these kind of systems.

Interviewer

OK, got it. So now I'll move to the following question. So what are the key aspects to consider for the maintenance and the durability of solar cooling integrated facades?

Interviewee 14

Can you repeat that question please? Sorry.

Interviewer

What are the key aspects to consider for the maintenance and the durability of solar cooling integrated facades?

Interviewee 14

I mean it's kind back to the same issue, a little bit. That you have the maintenance circle of your facade components and then you have a maintenance circle of MEP product which might also be the lifespan of certain façade products might extend the one...I mean if you look into lifespan of the interior and MEP, it's most of the time not as long as the lifespan of your facade. So this could be an issue. I mean PV and solar thermal, they are, especially the ones that are developed for facade integration, they are rather long lasting. But when it then comes to integrating more MEP technology to add the cooling as well within the façade, this could be an issue that you have different cycles of maintenance and exchange than you would have with the facade. So you need to align those. Then of course also an issue of accessibility which you need to ensure that ideally you can access from the interior, especially if you're working on a high rise building, so I don't have a big of an issue. Well, in a high rise you probably have BMU so, might not be too bad afterward. But that you have a good exit accessibility for maintenance, especially if, for example, there is AC component run by PV that you can access it. You can exchange it. You have cooling fluids that you might need to add up to. So there's more maintenance needed than what you might have to do for your typical facade. But it I don't see this as major issues. It's just like planning ahead how you can access it and then it's with your MEP cycle. But it comes back to this integration of fears.

Interviewer

OK, so now we'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 14

I mean aesthetics advantage are a little bit tricky because you can actively design with obviously PV panel or you can get a PV panel that has a colour and a fritting, so it doesn't look like the PV panel anymore so....The thing is I think it's less about let's say the looks but more about the flexibility. So you need to give the chance to design with the product rather to say....This comes back a little bit to the issue that sometimes it's more likely MEP product and MEP product is there's a catalogue. This is the product. You need this room to put in your ventilation unit. Done. But when you talk about the aesthetics and the facade as the exterior of the building as a major role in the architectural design intent....is not just gonna say OK, my PV panel is 1 by 2 meters and I'm using this because this is what the MEP planner tells me to put there. But he says I want this kind of....I want different sizes....I wanted triangulated....I wonder like a geometric facade design. So I think it's less about what kind of aesthetic does the product need to have because also the this is quite subjective and changes during the time, but it's rather how flexible is the solution and the product to be designed with so that the architect can say "I want this let's say key performance. I want for the Photovoltaic to produce electricity, but I have a certain flexibility to use this technology and fits my design intent".

Interviewer

I see. Got it. So now I'll move to the following category of questions. So I have two questions about financial aspects. So now in your experience, how can the industry develop affordable and financially feasible facade products integrating such technologies?

Interviewee 14

Yeah and then I am questioning is the industry the right person to do this? So because from my experience.....So for example, when you talk about solar thermal.....For example, the typical solar thermal industry in Germany, they're not interested in developing solutions for facade integration. And even less interested in developing an integrated solution on solar thermal, solar cooling, within the facade. They produce their solar thermal collector. They have the flat collector and you can put it on your roof and then they also sell you the heating system with it. So and therefore I think it's more the various stakeholders that are involved in building construction. I mean, of course, one driver is financial, so to say political support. So if you say I wanna do something new. I wanna realize like multifunctional facade, integrated solar thermal and cooling unit that hasn't been done before that they have some support to do this like a funding scheme from the state and the ministry....Well from our experience for investors for developers, this quite interesting. For clients, they say, OK, I'm actually interested in doing something new, but it costs more and there's a higher risk, so if there's someone who buffers these costs and this is interesting, and then my question how can we develop more let's say cost effective solutions. In the end, it's with everything, it's a question of scathing. In the beginning, it will always be more expensive, and then the wider it's used, the cheaper it gets. So also the bigger the knowledge and the acceptance get and the application, it cheaper it will get. So it's a tricky suggestion, but I mean it's with everything like this. You will always have early adopters who are willing to pay more for it because they believe in this new technology. So I mean the question would be, does it make sense to go into a more modular system that has like standard sizes, so it's easier to produce. Do you go into a more individual approach so you can go into high pricey projects where there might be a higher budget to realize these kind of facades. So it's not one way street. It's like....Depends from where you're approaching it from. And I would assume that this is a more higher price and high technology approach. So in general.....But at least from our experience, it's nothing that you get in the beginning. It degraded into a low class project to a low budget project. So the question is it the first thing you need to do? Do need to make it cheaper or you need to make it better to be realized in a high quality in landmark projects, so you get a bigger feasibility and a higher acceptance of these technologies and then from there lower, let's say the aesthetics, the complexity, the costs. And then go into a private broader usage where you can also do it for a multi-storey family housing.

Interviewer

OK, so now since you talked about the incentives, so what are the potential financial incentives that can support the widespread application of such technologies?

Interviewee 14

As I said so, one of course always funding, state funding, either for realizing it or for let's say produce your own electricity. Or on the other hand, this is also widely discussed a of course, your pursuit of funding is price increase on another level. So if electricity to run your AC, your centralized AC, is becoming more expensive and you might be more interested in doing a decentralized autarkic system and alternatively if you have like a low efficient and or least sustainable building.....If you have to pay fees for this, so to say. I think step by step we're going to start because we need to

change and if....Unfortunately, in a lot of cases it can only be done through financial impulses and it's either giving money or charging money.

Interviewer

So OK now I am done with the financial aspects. So now I have the last part. I have questions about stakeholders and processes. So I'll start with the questions about stakeholders. So now you can see from this chart we have different stakeholders involved in the façade design and construction. So the question is in your experience, which of these stakeholders can support the application of solar cooling integrated facades?

Interviewee 14

Well it's a tricky thing when I talk about building construction. Then it could potentially be any of those, but ideally it should be all of them. Simply said because the problem is if there's one of them really going for it and the others they're not interested in, it's not gonna happen. And if for example the architect is really keen on it and the investor is not in, it's not gonna happen, and the other way around. So in the end, at least, everybody needs to be a little bit on board. Otherwise is not gonna work or it's not becoming a good solution. So from our own experience, if you have an, especially if you have like let's call it an innovative solution, and there's only one stakeholder who like not really into it and not thinking about it and not dealing with it, I don't care about it, then you're only gonna get problems.

Interviewer

OK, I see. So now I'll move to the following question. Since we talked a lot about the knowledge and experience. So how can we increase the knowledge and experience of architects or engineers regarding technical aspects of integrating such technologies into facades?

Interviewee 14

I mean I would just assume it's the standard ways of getting them there. I mean starting from teaching about it. Also coming to the interdisciplinary approach that is needed for that starting in their studies, in their training....and then I think what....For example, for architects in Germany or also in a lot of other countries, if you need to do certified trainings to keep your title to stay in the architecture association....this for sure or something where I can approach people. Wide their knowledge....And from my experience, what....at least for architects and probably also investors, always works really good if you have built examples, well realized built examples, because you can talk a lot about it in theory, but in the end you need to show that it works. You need to show that it can be integrated. That it lasts. Also it promises that it can perform the way it's planned. And simply said also that it looks good. So the experience we got is that, for example, talking about PV, that a lot of times architects they are might be interested in and then they come along with nice project examples. They don't even have to be from the own office, but from other offices where they say this was well published and they would like a huge PV facade and that looked like PV and these kind of things. So they show examples and say, OK, this is something I saw I thought interesting and can we do something similar? Can we learn from this? So I think it's a lot of doing prototype and doing projects and publishing those. I mean, for me as an architect, we like to look at images and not to read too much about theory, but if you have a nice image and then it says it's a solar cooling, it looks really nice and it's nicely done.

Interviewer

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

Interviewee 14

Tricky question. I mean the one thing that I mentioned earlier is if in regulations, you step by step ask for, maybe not specifically these technologies, but that you need to reduce the energy supply externally or to become more autarkic, more sustainable. This is for sure something happening and being relevant and of course when it comes to guidelines.....I mean also when it comes to regulation and guidelines, regulations to a certain extent are good because also gives you a guidelines and it forces you to do something, but a lot of times it also limits new approaches and innovations. So it makes it more complicated to go for something new and I will still, unfortunately, would still consider these technologies something new, especially if I go after German regulations. So you don't find too many of these kind of products that are covered by norms and that have a building certificate. So it's always a more complex process to get this kind of facades built.

Interviewer

OK, so now I'll move to the following question. So how can the industry increase the variety of products to attract customers to apply a façade products integrating solar cooling technologies?

Interviewee 14

I mean the question is.....I find it quite broad question because the question is what is the industry and what is the product? The product might also be a combination of products and the question is does it simply just need more products that have different performance levels and therefore different price points, or do I need to have more products saying as a different colour variation, or is it more like one product system that is more flexible? Yeah, I mean the problem with just widening the product catalogue, so to say, is that every product has an investment cost. And the more products you have, the less scaling you have. So it's not becoming cheaper. I'm not sure if going...or let's say that a broader variation would solve the problem. A Broader variation of products. It may be rather either a broader variation, a broader flexibility, or a more detailed planning and interaction between the product supplier and the planning team. Because I mean going back to saying my PV panel is 1 by 2 meters and that's it. And then the architect said "well but I don't want it to be 1 by 2 meters", but when he goes for brick façade, he also accepts that there are standard sizes for bricks. So the question is can I have kind of a product and then more consult on the product and support and have an understanding what does it mean to design and realize a whole complex building with it rather than just saying "this is my product and by the way I have another product which has a different size but it looks exactly the same". I mean it's a little bit tricky thing with building construction. Especially the field or the projects that we are working on, there are always very individual large scale projects. So of course there is always another market where it's more about having a cost efficient. Realization is not too much about design and individual approach, but I'm talking from my experience and the field I'm working in, and there I would say it's more important to be flexible and go into an interaction and then into an individual design for the project, rather than saying you can choose between 2 to 3 products. And then the architects, well I like the product in between those two. So to say I want to design. I want to have something individually between those two.

Interviewer

OK, got it. So now I'll move to the following question. So how can we increase the interest of designers, developers or clients about the integration of such technologies into facades?

Interviewee 14

I got a feeling that the interest is already increasing due to various factors. So I think generally it's just developing new solutions, showcasing solutions, talking about it, publishing these kind of solutions, being on fairs. I mean in the end it's typical public relations marketing, because I would say it's....We're not at a point anymore where you need to convince the other stakeholders that it would make sense to do something like this, but they're already interested in it. So it's rather a question how can you get this information to those people? I think it...Well for my experience, it's not about if you need to convince them anymore that it might be a good idea to use photovoltaics or solar thermal, or think about energy efficient cooling. They're all keen on learning about this.

Interviewer

OK, I see. So now you talked previously about the regulations, talked about different sides of the regulation. So you said it before about that in some way there is a good aspect and then and sometimes it has negative aspects. So for example you said about it can limit new approaches and things like that. So I think you already discussed things about the building regulations and how it affects the widespread application of such facade products. So do you have other remarks about it or I can move to following question?

Interviewee 14

I mean about regulations in general....No....

I mean I would say it's probably relevant or important to maybe speed up the process of setting up regulations because they just don't include a lot of these technologies. Even when you talk about a simple laminated PV panel, it doesn't count as a laminated glass and a laminated glass is the standard product which is covered by standards. So you know how you can use it and it's regulated. But once you put the PV inside, it's a nonregulated product, although it performs more or less the same.

Interviewer

OK. I got your point. So now we talked about the regulations. So but how can the changes in energy policies....How can changes in energy policies affect the widespread application of such technologies?

Interviewee 14

I would say as I mentioned before, it could be a huge driver because unfortunately and it's always about the money, and if I increase fees for being less energy efficient, then they're in for the kind more energy efficient, or if just the energy prices go through the roof then might be more interested in producing my own energy or using less energy for cooling, etcetera.

Interviewer

OK. So now I'll move to the last part before the closing questions. So now you see from this diagram we have different phases or different processes to develop façade products. We have the design phase, production phase, assembly, operation and then we have the end of life. So in your

experience, which phase is key for boosting the integration of solar cooling technologies into building facades?

Interviewee 14

But I would say in.....If you say which is the main phase to boost it, I would say it's the design phase and the earlier the better, because on the other way around, the problem is the later you want to integrate something like this, the less you are able to do but this is for everything. So if in the beginning the architect says I want a stone facade and then in production phase you say "but the metal cladding would be more resource efficient", there's no way you're gonna go from a stone to a metal facade. So this is like the mechanic...the earlier you can make decisions, the less costly it is, the easier can make them. So ideally and also as it....contributes even more to a holistic approach because it is becoming part of the MEP system. Even more important that you have at least rough idea that you wanna do it as soon as possible.

Interviewer

OK, I see. So now what are the main aspects to consider in the design phase?

Interviewee 14

I would say the main aspects is to generally already decide what do you wanna do in general, and then also design accordingly. I mean we're going back to the location, so if I design a building with a huge north facing facade then they say OK, I wanna use this to produce my electricity for cooling, probably not gonna work. So it's more to make decisions and also understand the overall design and, let's say, performance correlations.

Interviewer

OK. So now how can we achieve a closer collaboration between various stakeholders and disciplines during early design stages?

Interviewee 14

By hiring them all in the earlier stage. So they like....from own experience as well, facade consultant, in a lot of cases, the client doesn't want to spend the money in the early phase for all specialized planers. He said "the architect, he can do it" and then later on I get someone involved who is double checking what the architect was planning, but he might not have the full in depth experience on it. So he can't design in this depth and make decisions.

Interviewer

OK, OK. So now we have the production, assembly, operation, and then end of life. So in your opinion, what are the main aspects that should be considered for production, assembly, operation, and then end of life. So just one by one. So we talked about the design, then we have the production assembly, then operation, and end of life.

Interviewee 14

Well, for production phase, it's probably how they are integrated into the facade, which is the same like in the assembly phase. Like how do I get them involved and how is the interface between the various disciplines. And the operation phase is probably rather how to properly operate it and how to maintain it and access it, and then end of life of course becomes interesting how can I, when I talk about multifunctional parts, how can I get it separated in the end.

Interviewer

So I just have a question about the assembly. So do you have something in mind about the key aspects to consider for the required workforce?

Interviewee 14

I mean in the end I would say for any kind of facade installation, we should probably have someone who is trained in it, and then it's just need to train your workforce for this specific task. It might be that you need various disciplines, which makes it a little bit more complex.

Interviewer

So just one point before I close. So what are the key aspects to consider for the end user knowledge during the operation phase?

Interviewee 14

I mean it depends how it's....how the system is designed. If the user has the power to override the system with obviously he needs ideally a training as well, because otherwise you may just use it wrong, which is in a lot of cases happens in the building operation that the performance is not as good because the user is making the wrong decisions.

Interviewer

OK, so now it's just the last part. The closing questions. So what are your final remarks about supporting the widespread application of solar cooling integrated facades?

Interviewee 14

Well, I think in general my feeling is that the general interest and acceptance is rising. So I'm looking forward to having a more application and realized projects which will then increase the acceptance even further. However, I still see, wouldn't really call it technical problems, but maybe it's due to technical reasons and complexity cost concerns from fabricators, for contractors.

Interviewer

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

Interviewee 14

Generally I mean I find it really interesting as it will ease and will be one of the main challenges that we're facing. Question is always does it all have to be integrated into facade or is it a combination of decentralized and centralized systems? And this is very project specific, I would say. So but then....Generally I'm really interested in it. It's also why we've been doing research in this field for quite some time.

Interviewer

I see. So do you mind to propose potential participants to be interviewed for the study?

Interviewee 14

I can check. I will note it down and I will write you some ideas that you have.....