Jim Logan

On the design of Wild Sage Co-Housing, Boulder, Colorado

an interview with N.J. Unaka and Jim Wasley, UW-Milwaukee

NJ Onaka: Could you speak generally about how you came to participate in this project? Who was at the table when the project was hatched?

Jim Logan: The project was initiated by the Boulder Housing Partners. That is a nonprofit that owned the land, and they served as the primary site developer. They then brought in five other developers to work in different parts of the site. Jim Leach of Wonderland Hill Development Company approached me and asked me if I would like to design one block of co-housing. I said I would, and that was basically it – we concluded a deal in the parking lot. That was all it took.

NJ Onaka: And the Holiday Neighborhood Homeowners Association wasn't participating in this part of the project?

Jim Logan: No, at that time there was no homeowners association. Boulder Housing Partners acted as the overseer of the whole thing, and they set the rules. They had a requirement of 40 percent permanently affordable housing, according to the city's rules of percentage of average monthly income. That was the covenant that had been placed on the land when they received it from the city. They were then trying to bring in developers who were willing to try to develop a for-market product that included 40 percent of it meeting the affordability guidelines and could still make a profit.

There was no subsidy to anybody. The developers bought the land at market prices, basically.

NJ Onaka: The developer for this particular block, Wonderland Hill Development Company, what kind of experience did they bring in doing sustainable communities or co-housing, or just as a developer in general?

Jim Logan: They brought a lot of experience. Jim Leach has been doing housing development work for 30 or 40 years and has done thousands of units all over. He's always had an interest in energy stuff. In the '70s, when we were doing active solar systems and first working on passive solar and stuff, he built a lot of product around town that was just market-rate stuff but, though, was trying to be progressive in the way that we understood it in the '70s in the first energy crisis.

Over the past ten years, Jim became very interested in co-housing and started working with co-housing communities as a developer, helping them build their community. In the process of that, he realized that he could actually, as a developer, initiate co-housing communities. That's what he did here.

He went to Boulder Housing Partners and said, I'll sign a contract to buy this block. Then he went to the community and said, I want this to be a co-housing community. Who would like to be a part of this community and live here?

So, he brought together the future people to live there, and then I started working directly with them, doing a design that met their requirements, that met Jim's requirements in terms of what he wanted to sell and could afford to build, and then what met Boulder Housing Partners' requirements in terms of the overall community and their desires.

They wanted to be a new urbanist type of community with buildings close to the street, parking interior to the lots, no garage doors, really, on the street to speak of.

Boulder Housing Partners held the overall community vision, Jim held the money, and the co-housing buyers then also were saying

what they wanted it to be.

Jim Wasley: How does doing co-housing change your design process, and how do you manage that so that it doesn't become a runaway cost or something that derails the project timeline?

Jim Logan: It's really hard, actually, because you get 80 percent of the people that like what you're doing, that are happy with it, and go, oh, this is great. We've hired this architect and we'll trust him. Then you get 20 percent of the people that want to micromanage. They want, basically, a unit designed for them, which is really not what's going on. You can't really get into custom-making the unit for people at this price point.

Actually, interestingly enough, most of the people who were very demanding and we ended up doing things very specifically for to try to make them happy, in the end didn't buy into the project. They all left. Because you do have turnover in the group, it took three or four years to get everything to happen.

So, the group that you start with who made the initial decisions about how the community house was gonna be, what amenities were gonna be provided, and things like that, by the time you actually get it done and you sell it, you've got almost a completely different group of people. It's changed that much.

Jim Wasley: The developer bought the land at market rate, but doesn't the city make it either much easier to build if you include affordable housing and much harder to build if you don't? Wasn't there some city framework that drove it towards the goal of affordability?

Jim Logan: The city framework that is currently in place, that I believe was in place at that time, was that anybody building any new housing has to have 20 percent of it be permanently affordable. Anybody that's building five units has to provide one permanently affordable unit. If you're doing less than five units, you have to pay money into the housing fund.

So, if I just wanna build myself a house and I buy a lot that doesn't have a house on it, I have to write a check for $20,000.00 to the city affordable housing fund. That's been well

established.

The difference here was that the requirement wasn't for 20 percent, it was for 40 percent, which just made it financially tougher on the developers. Other than that, they didn't offer any incentives or give money. The 20 percent has always been this is just the law and that's what you do. Now it was, if you're gonna build it in this development and be part of it, it's gotta be 40 percent. They don't add any financial incentives.

NJ Onaka: Could you briefly describe the approval process and speak to whether it was more or less challenging than any other project?

Jim Logan: The approval process on this with the government entities, the city and Boulder Housing Partners, was actually easier than any other project I've done because we were part of a whole many-year effort. The whole north part of the city had been rezoned and county areas had been annexed into the city. This was such a large project that our block didn't actually receive any scrutiny. There was kind of planning fatigue going on, I think, because so much had happened over so many years that I think everybody was just kind of tired of going to meetings.

Usually, if you do a whole block in a city, it's a very big deal and there's a lot of scrutiny and a lot of discussion. Everybody talks about it. But because we were one of eight blocks in a really large thing, they didn't actually beat up on us at all. Things that they normally beat up on you on, like the colors and all that kinda stuff, we just slid right on through. They were happy. So, it was really easy from a regulatory point of view just because it was part of such a giant thing.

NJ Onaka: That also includes Boulder's residential green code mandate?

Jim Logan: Yeah. The mandate at that time required very little smaller units. When you were building units that were less than 2,000 square feet, the requirements were pretty minimal. By the nature of what we were doing, we were so far ahead of them that we paid no attention to them. We just filled out the form at the end and we had lots more points than they wanted

us to have.

NJ Onaka: That process is more stringent now?

Jim Logan: It is. I talked the city council into requiring all multifamily housing to be 30 percent better than code. What we have now is we use a system called a HERS rating system, which is a national system put in place by the Department of Energy and the mortgage people, by a group called RESNET. It's a national rating system for energy efficiency. It's used for ENERGY STAR.

ENERGY STAR is 15 percent better than code. So, an ENERGY STAR building would have a HERS rating of 85. A building code building would have a HERS rating of 100. In Boulder now, anything you do has to have at least a HERS rating of 70. Seventy is the minimum HERS rating even for multifamily, even if it's small. Which is my fault, but I think it's important. (He laughs.)

My house has a HERS rating of minus-eight. (Laughter all around.)

NJ Onaka: How did the co-housing work with affordable housing? Was that an issue?

Jim Logan: I think all the co-housing people are very tolerant of different income groups. It's essentially a group of people that all want to live together. It's an intentional community.

The only problem with the income thing was that there were a number of people who really wanted to be in the community, and everybody wanted them to be in the community, and they needed to be on the affordable side. They couldn't afford to buy a market-rate unit. So, there were a few people who had too much income to be in the affordable housing program but not enough income to just buy a unit. So, a few people dropped out from that but very much wanted to be in the community.

NJ Onaka: Were there any people who dropped out because they were – although they met the requirements, still couldn't afford it? In other words, they were on the other side of that range?

Jim Logan: Possibly. I'm not really sure. I don't really

remember. But I'm sure that would have been a likely case, that people just didn't have enough money to pay for a mortgage.

NJ Onaka: To get the affordable housing, you had to be within a certain income range?

Jim Logan: You had to be in a remarkably narrow range, actually. You had to have enough income to meet the requirements for the mortgage, even at the reduced price, and then you had to have not too much income so that you would still qualify.

Now, the four Habitat units were in a different formula because they do their own lending. Habitat is a mortgage company. They have their own mortgage rules unique to them.

Jim Wasley: That's interesting. The other thing that you said earlier, just to get you to elaborate on it a bit, was that the combination of affordable housing and co-housing worked very well for single parents and especially for the children. That it's a natural fit. So did the project attracted a lot of single parents?

Jim Logan: Yeah. Being a single parent with children moves you up in the affordable housing rules, and you qualify much easier if you have more children. Single parents wanted to be in this project. They saw it as a great place to be for lots of other single parents and lots of children. Like Hillary Clinton said, and somebody before that, it takes a village to raise a child. There you have a village. So, it's great. All the kids are a gang on Saturday morning. The single-parent people liked the idea of it and wanted to be there.

NJ Onaka: Could you also speak about more infrastructure-type incentives? You spoke earlier about the incentives for purchasing photovoltaics.

Jim Logan: Well, the economic rules for renewables and the interaction with the utility companies vary state by state. In the state of Colorado, we had a citizen's initiative that was later made more stringent by the legislature that requires the utility company, Xcel Energy, to provide 20 percent of all our power from renewables by, I believe, 2020. I think, actually, that the original rule required that some percentage of

that come from photovoltaics to keep them from just going and buying some giant wind farm somewhere.

They started subsidizing photovoltaics. In the beginning, when the program started, the subsidies were really heavy. There was $4.50 a watt of subsidy available. As the federal tax credit came in, the 30 percent federal tax credit, and as the price of installation has dropped, they found they were getting more people joining the program than they wanted to. And so they've gradually cut back those incentives. I think now we're at $2.50 a watt.

But we've also seen the market price of photovoltaic systems drop dramatically over the past three or four years. We started at about $9.00 or $10.00 a watt of actual cost before any subsidies or tax credits. Now we're seeing a lot of systems at $6.00 and even some slightly under $6.00 a watt. Photovoltaics are getting cheaper, and then we have these statewide incentives that help subsidize it.

NJ Onaka: You weren't able to take advantage of that for the Wild Sage project?

Jim Logan: At the time we did the Wild Sage project, none of these incentives existed. In fact, at that time, the utility company was not required to net meter or to buy electricity. Right now, if you have a photovoltaic system, they're required to pay you for extra electricity and to essentially act as a provider where you can buy and sell electricity into the grid and have a net metering situation.

Jim Wasley: Do they actually pay you money, or do they give you a credit?

Jim Logan: They give you a credit until January, and then in January they pay up. When they pay up in January, they used to be able to pay the price of their cheapest electricity they were buying in the grid anywhere. Now they can't do that. They have to pay the average wholesale cost of the electricity they buy.

NJ Onaka: Were there other of these kinds of incentives for infrastructure improvements, say for insulation, that would encourage you to build more energy efficiently?

Jim Logan: There are current federal tax incentives. The problem is that if you're doing it for a housing authority or a nonprofit, it's very difficult to take them because they're tax incentives. To get a tax incentive, you have to have income, which nonprofits don't have.

Anyway, the tax structure is really complicated, but there are currently federal incentives for insulation, for better quality windows, for photovoltaics, for solar thermal, for small wind, and for geothermal. Geothermal got a big boost – there's now a 30 percent tax credit for geothermal energy.

Jim Wasley: That's interesting.

NJ Onaka: Was Holiday Neighborhood an existing development or was Wild Sage planned concurrently?

Jim Logan: Holiday was the largest empty developable piece of developable land left in the city. It had been a drive-in movie theater, which is why it existed as one piece. It had been sold to a series of developers who wanted to do mostly big-box retail, and the city had been fighting against this – this large piece of land on the perimeter that we didn't really see as appropriate for strip mall kind of development because we have the idea that our shopping should be in the core where we can serve it by mass transit and not on the perimeter. That was the basic history of the battle that had been going on.

At one point, one of the developers said, maybe almost in jest, 'well, if you guys wanna control it, why don't you just buy it?' The city said, 'that's a good idea,' and they bought it. So the city bought the property to keep it from being big-box retail and then transferred ownership to the Boulder Housing Partners, which is our nonprofit housing development agency, with the covenant that 40 percent of it had to be permanently affordable.

NJ Onaka: How exactly does Wild Sage fit into the master development or the overall master plan?

Jim Logan: I think in the community that there's not a sense of anybody knowing which developer did which part. I think people are really happy living there. The whole thing is very much a

community.

The Wild Sage Common House serves as the community center for the whole neighborhood. People rent it for weddings. If there's a meeting that involves the whole community, it always takes place there. There's music once a week there that anybody can come to. So, it ended up being the common house for the co-housing community, but it really does function as the place for the whole area to get together whenever they have a reason to.

Jim Wasley: That's interesting. It's not the only co-housing community in the neighborhood, right?

Jim Logan: No. after Wild Sage was finished, there was a block that was actually not part of the Holiday Neighborhood and that was held by somebody else. Jim Leach bought it and did another co-housing block, which he called Silver Sage, which is co-housing for elderly people. So, immediately now to the south of the Wild Sage project is the Silver Sage block of elderly housing.

Then, south of that is a project that he built called Solar Row, which is carbon-neutral or close to carbon-neutral. It was done as market-rate stuff.

Jim Wasley: Wild Sage became a hub for everything just because of the demographic? You've got younger families and kids…

Jim Logan: It happened to be in the middle. I think people like the building. They like the common house. The common house at Silver Sage is quite small and dark. The Wild Sage one is bigger and well lit.

NJ Onaka: This Solar Row, though, is not part of Holiday and therefore didn't have to meet the 40 percent.

Jim Logan: No.

NJ Onaka: But it did have to meet the 20 percent?

Jim Logan: That's correct.

NJ Onaka: So it does have some affordable units.

Jim Logan: Yes.

Jim Wasley: We actually drew that, although we dropped it after the studio ended due to a lack of manpower.

Jim Logan: One of the units has been followed by National Renewable Energy Labs, and so there's probably numbers on it but its probably not the affordable unit. I don't really know – I wasn't involved with Solar Row. But if you guys wanted to talk to George Watt, George Watt was the urban designer for the whole Holiday Neighborhood. Then he designed the Solar Row.

NJ Onaka: Especially with the common house being sort of the community center, how did fitting Wild Sage into the overall masterplan affect the design?

Jim Logan: Well, I just wanted to make sure that the common house was welcoming to the community. It's a great little design project because it's trying to make a room with a kitchen that they can cook in, that they can play music in. It was fun. I didn't let anybody else in the office work on it. I did it myself one day.

NJ Onaka: Finally, what do you think are the lessons from this in terms of getting past the mind block about carbon-neutral design, on the one hand, and also sort of affordable housing attempting to be net zero and/or carbon-neutral?

Jim Logan: Well, if you decide that a project is gonna be carbon-neutral from the get-go, your design starts out totally different. This is the first step. I think traditionally what we've done is that we've designed buildings the way we always did, and then we have attempted to overlay this energy stuff on top of it.

What we do is we start from the get-go saying this is gonna be a carbon-neutral building. What does that mean? What's it gonna look like because it's gonna be carbon-neutral? It needs some passive solar. It needs some place for photovoltaics. It needs all these things. It needs to be naturally lit so we don't have to put lights on in the daytime. Immediately, you bring all these design drivers in.

The other thing that happens, too, is, just

technically within the building, if you say it's gonna be carbon-neutral, that pretty quickly implies a level of efficiency that totally changes the mechanical systems. Automatically, we need to have an air heat exchanger for air quality. Once we have that, now we need a way to deliver that air throughout the building. If we're in a climate where we need air conditioning, then probably we want to tie those things together. The way that we're gonna heat it is probably different, and how we're gonna make our hot water work is probably gonna change.

I think you get to a different set of results if you start from 'this is gonna be carbon-neutral.' I think what most people do, because they haven't done it as long as we've done it, is that they say 'this is how we make an apartment,' or 'this is how we make a house.' Then they say, how do we make this house carbon-neutral? I think you really need to state your goals from the get-go and start there with the design.

On the climbing gym (another of Logan's projects in Boulder), we said 'this building is gonna be 100 percent daylit. Any light that's on in the day is a failure on our part as designers.' That was what we wanted, because we knew that was where the energy efficiency lay, was in no lights. In a house, lights count, too. So how do you get it to be daylit?

I think, in terms of carbon-neutrality as a goal, starting from that point of view is really important. You create a different building when that's what you're gonna do.

NJ Onaka: Could you speak a bit more about how the use of the equipment within the building serves to cut down on the mechanical systems?

Jim Logan: Well, in traditional buildings, the heat loss and heat gain loads are substantially higher than in these carbon-neutral buildings that we're doing, so you need bigger equipment and you need the ability to move a lot of heat around within the building. What we're finding when we achieve really high levels of insulation and a really low air change rates is that the amount of energy that we need is really, really small. Things like body heat and heat from

appliances, televisions, and things like that start to be a really significant numerical part of the building.

The first problem is that it's really hard to find equipment that's small enough. Very little equipment is made to meet these very small loads. Things that don't intuitively make sense, like using little-resistance electric heaters, actually can make sense in these really low-energy buildings.

So what we're doing is we're taking money out of the mechanical systems and we're putting it into the envelope. We're buying a better envelope and we're buying less mechanical equipment, and sometimes less expensive mechanical equipment, than we would otherwise.

I think the most important thing, though, especially in the affordable housing genre, and all public buildings, is to shift the timeframe from looking at initial cost or cost over three years or cost over ten years, and start looking at a longer timeframe. We look at 30 years, 50 years, or 100 years, and we add up all the costs of a system: the initial cost, the operating cost, the repair cost, the maintenance cost.

Those are really the real costs. If we just move our timeframe out to a much longer timeframe, then we find that we make different decisions up front that may increase the first costs somewhat, but a lot of these things become cheaper in a fairly short amount of time, like three to five years.

In the affordable housing market or rental housing market, the maintenance costs on the unit can be the largest expense of the agency. If we can reduce those expenses, then we've dramatically changed their economics. We need to be able to build buildings that, if you look at a longer time period and take all the cost, all the maintenance, all the painting, all the repairs into account, then we end up making a different set of decisions.

Interview with Jim Logan Logan- Part 2
Interviewed by NJ Unaka and Jim Logan Wasley
September 19, 2009

Jim Logan — I think that siding is a very poor choice economically, over time, and it's also a very poor choice environmentally. I think paint is a disaster, basically. The manufacture of it, the disposal of it, the doing it over and over, some of the ways buildings used to be made were much more durable. Making buildings that don't leak, having great detailing so that they don't leak, paying attention to vapor transmission through the envelope, building science, actually. Making it so that the wall doesn't rot. If there happens to be a leak that it doesn't destroy the wall, the building can handle mistakes, as it were. I think that these things are really important.

Jim Wasley (JW): — We'd like to get your wisdom on other kinds of housing- rental properties, for example, which are close to typical affordable housing in their construction.

Jim Logan: — The most expensive floor you can have is carpet. The most unhealthy, the most dirty, the most expensive if you look at anything except first costs, because you have to replace the carpet every five years, and a hardwood floor, or a tile floor, or concrete floor, or linoleum floor will last a really long time.

So that comes back to the time function. And some things that now are thought to be green, like instantaneous hot water heaters, if you look at maintenance the whole thing falls apart. It falls apart because you are supposed to take the heat exchanger out and flush it with vinegar once a year, which nobody does, and if you did do it, it would be three hundred bucks a year…

NJ Unaka (N J): — Is that just because of the design of the unit?

Jim Logan: — If there is any mineralization of the water … in the west, there's a lot of minerals in the water, so it gets coated with lime and that needs to be de-limed once a year. And if you don't, it voids the guarantees. You are supposed to de-lime it, and no one de-limes it.

JW: — That a really interesting conundrum. It seems like we are still constantly bumping into where high tech or 'efficient'

technology gets complicated. Certainly the rap that it has in the marketplace is that it is complicated and fussy and is going to break down and be expensive to run.

Jim Logan: So there is a water heater brand called Marathon, made by Rheem, a national water heater company. It's a polyurethane tank, with foam blown into another tank. It's a big plastic tank with a resistance element for a heat source. And if you ask anybody, they would claim resistance electric is the worst possible environmental choice, but if I buy this hot water heater….

N J: Why would they say that?

Jim Logan: Typically it uses a lot of energy that comes from coal.

But if I say I am going to have both the tanks and photovoltaics, and I have my photovoltaics being reasonably economical, then the cheaper component in dollars is the PV, if I look at it long term. A regular hot water heater you have to throw away every eight years. Very often it wrecks a substantial part of the building in the process of going down; it leaks, and that wrecks floors and so on. So if I take all of that into consideration over the life of the building, then the plastic tank with its resistance element, running off of photovoltaic power, is cheaper! It's carbon neutral and it costs less money.

N J: Some systems I've seen will have both a heater in the tank and the on-demand heater, so that the tank brings the water to a certain temperature and the on-demand heater just boosts it up a bit.

Jim Logan: But then you've got two pieces of equipment, you've spent four grand on the on-demand, and you've got the tank for four hundred, but you've got to buy a new tank every eight years, and the on-demand, if we don't demineralize it, you've probably got to buy a new one of those every eight years.

N J: This example is very similar to the one you were talking about with the window glazing- replacing the individual panes of glass versus the whole unit.

Jim Logan: I think this is the dimension of time again. As soon as you start looking at it over time, you make a whole different set of design choices. If you say, "I am going to be carbon neutral, I'm going to have some photovoltaics,' then everything changes. I've already got some photovoltaics on my house, and I've got more electrical energy in the summer than I can use, anyway, so my hot water decision becomes a different decision, really.

N J: So even your carbon-neutral decisions about embodied materials change, because you are looking really at the running and the maintenance of each of the systems, and even if you end up using something, that on the face of it, doesn't look very good on the carbon charts, that because of the maintenance costs, the feasibility of running on clean power, it becomes the better choice.

Jim Logan: Yes, exactly.

JW: In looking at total environmental impact, talking about material costs is still very hard- the numbers are hard to pin down. But life-cycle costs seem very quantifiable; it seems that we should be able to know that information. So that's the question: Do you think you can come to intuitively correct answers about which solutions are going to last longer, or are there things about building for durability that are also counter intuitive? Some of the things you are describing seem counterintuitive, because we think of them as being cheap but we don't think about the fact that they are easy to maintain.

Jim Logan: 'Easy to maintain' actually becomes the big thing. I've built more solar-thermal systems probably than anyone in the country. I've been doing it for thirty years. Big ones, and little ones, and commercial ones, and residential, and they always fuck up! They always have to be worked on and they never work out of the box. I just decided that I'm not going to fight the fight anymore.

I mean, if somebody has a national company, like KIA or Ford or somebody that makes solar hot water heaters, and guarantees them, and installs them, and they cost four thousand dollars, then I am all over it. But now, they cost eight thousand dollars and they don't work! The guy has to come all the time to make it work, but often people don't even know that it's broken. I've given up on that one. I'm not going to go there.

I think in the climbing gym, where we have one simple system that's making hot water for eight showers and a clothes washer- that's ok. I'm fine with that one. But not for space heating.

JW: One thing you said, that we need to think about in general, is how do you know when it's not working?

Jim Logan: It's really important.

JW: That's a long term-thinking question…if you were to define all of the attributes of thinking for the long term, one would be that when it is failing, it is clear that it is failing.

Jim Logan: Yeah, if you have a photovoltaic system, and it stops working, you see it immediately. My electric bill is seven dollars every month, so I expect it to be seven dollars from now on. So, if suddenly, it went from seven to fifty dollars, well then, whoa! It's broken.

That Lighthouse display screen that we looked at at the gym gets at this. They're putting that on all their systems on it now, and they are monitoring them and so if the photovoltaic stops making electricity, then they'll know, they'll see it.

And on the gym, if the PV are clean, the system generates up to eighty KW. You know that its at eighty, and at seventy or sixty they are wondering if they should go clean it. Then all of the sudden it gets down to 50 or 40 and they KNOW to send some kid up there to wash them off. So you have some way to know what's going on. With the solar thermal we don't generally have any way to know.

JW: The instrumentation is just too expensive?

Jim Logan: Yeah, the instrumentation has not really been worked out yet… anyway it just feels like a boutique- working some of the time but not robust enough. With PV, we just buy them, and put them on, and nobody ever calls us. It just happens. It makes better electricity than the utility company does, and all the computers are happier, and all the equipment is happier, so it just seems like a no-brainer to me.

So, the first thing in making it more efficient would be being aware of these materials choices and maintenance costs, and the time function.

N J: I had one question about integrating PV and solar hot water, with the hot water system cooling the PV. What do you think about that?

Jim Logan: I think in theory it could be great, because you are cooling the PV and increasing production. But, the issue with all solar-thermal is that we have kick-ass amounts of energy in July, in August…what are going to do with all this energy? Then in January, it's none, or very little. So if you look at the curve of production, it doesn't match the demand side of heating. It means that solar thermal makes sense when your load is constant, year-round, or bigger in the summertime.

Solar thermal is really great for swimming pools, hot tubs, commercial buildings that need a lot of hot water in the summer, but if you're tying it in any way to a heating cycle, then the output just collapses in December and January. I mean I've boiled six thousand gallons of hot water in July, and it's not a good thing to do.

N J: Couldn't you use it for cooling?

Jim Logan: You can use it for cooling, but you need a really big system to do that. There is a school building in Arizona that they're even using solar thermal for cooling, but the units are once again, from Japan, and the size? The smallest available is fifty tons or something like that.... So you need a big-ass building, and then you need somebody who works there, all day, every day, whose job it is to make it work. And there is a certain scale where you have that, with guys in blue coats and thermometers… but you also need somebody smart enough to do it, and who wants to be doing that.

Technically, there, I think in the next twenty years we will be using solar thermal for cooling in the desert. You can run a refrigeration cycle on hot water from the sun. It's not residential scale, its big building scale. But the equipment is manufactured. You can buy it in Japan.

JW: And we can buy our PV in China!

Jim Logan: And if it's for really cold climates, you can buy it from Canada.

It's pretty amazing that none of this equipment is made in the United States.

We are doing an performance hall for E-Town, the public radio show taped here in Boulder. I

am not the architect on it, I am just the eco-guy. We are running a mechanical system on mini-splits, where every room basically gets its own refrigeration based unit, which can either heat or cool. Because it is an existing building, we couldn't run air around the building- there just wasn't the space.

So we're moving refrigerant around the building, and every room gets a heat pump. That means that if I want open my window and turn my heat pump off, I can do it. If I've got a computer server, and I am too hot, I can cool. The heat that I am putting in over here, someone can use over there. So I can air condition on the south side in the sun, and provide heat on the north side.

JW: So, that temperature is being shared?

Jim Logan: We are running two refrigerant pipes to every unit, and then those all go back to a central box, which then looks at the aggregate need. So we've got our air source heat pump sitting outside on the river that looks at the refrigerant temperatures, and makes decisions…

The point is that there are two Japanese companies- Fujitsu and Mitsubishi that do it. It's really common there. Nobody in the US makes them.

We kept looking at the building, and asking ourselves, "How do we give people individual control?" Clearly, we are going to have parts that are always cooling, and parts that are going to want to heat all of the time. So, we knew we were going to have all these loads simultaneously.

So we said 'O.K., we'll go to mini-splits; everybody gets a little heat pump. The efficiencies are really close to geothermal- they are way up there, with very high C.O.P's. Remarkably efficient stuff and its all Japanese.

JW: And on the complexity scale, it isn't fussy?

Jim Logan: In Japan it's been around for a long time, and people seem to think of it as durable. I mean the technology, it's the same as your refrigerator. It's just a refrigerator, but instead of having all of the black pipe on the back, we will run it all the up to a

central unit. And if we had a lot of cooling load, we could put up an evaporative cooling tower...raising the efficiency even higher.

JW: Do you do all of your own energy modeling?

Jim Logan: Not on that project. I do all of the energy modeling on residential, because we wrote our own little program that we think is better than anyone else's. Just an excel spread sheet, but I can see all the numbers- there are no secrets. No code, just adds, and multiplies, and divides. Just degree-days. We've run it against really complicated programs, and we get similar values. I sent my little program to Craig Christiansen, who's in charge of all numerical data analysis at the National Renewable Energy Lab, and I asked him, Craig, "What do you think?" And he said, "You know I think you are giving a little more benefit to passive solar than you really should be with a straight face." But then he went on to say that we were pretty much spot-on.