“Script” for 1-Hour Intro to Passive House Slide Deck, September, 2021

The “script” is a guide - feel free to put into your own words and emphasis. Feel free to weave in your story. Make it genuine.

----------------------------------

1.

Welcome to An Introduction to Passive House. My name is \_\_\_\_\_\_ and I’m \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Thank you for joining this presentation. I hope it leaves you thinking differently about buildings and ready to act.

2.

PHN is a national non-profit organization that educates and builds peer-to-peer knowledge sharing networks across the US.

We work in support of professionals working with the international Passive House Standard and we are affiliated with the Passive House Institute and the International Passive House Association, based in Darmstadt Germany. We work in collaboration with the North American Certifiers Circle - 13 independent building certifiers workinging in the international standard - who share knowledge and make better buildings together.

We connect global knowledge, regional contexts and the needs of local applications. We connect you to others across the US and around the world.

And we want to encourage everyone to get Passive House training and education. Because as you’ll see, Passive House education really does change the way you think about buildings and work on buildings - Passive House education can transform our building industry culture and empower climate solutions.

3

So let’s begin.

Today we face interrelated and interlocking crises: environmental, health and social crises - and while, how we deal with them or not, is an individual choice, we all should be able to recognize the power of buildings to help solve our problems or to exacerbate them. As the Reverend Mariama White-Hammond of the Green Justice Coalition and others have said: “Building is not a neutral act.”

Passive House alone is not the solution to anything of course, but it uniquely supports solutions.

4

What’s different with Passive House is that it truly recognizes and embraces the power that buildings possess, what the architectural structure holds - and in so doing Passive House empowers architectural solutions to fundamental problems.

* We must eliminate carbon emissions - with Passive House the architecture itself can drive energy efficiency.
* We must protect health - Passive House places hygienic indoor environments as part of its foundational concept.
* We must provide storm resilience, and Passive House provides the most robust shelter-in-place potential possible.
* We must provide affordability - it cannot be for the 1% or the 10% but for all people. Passive House provides affordability both in initial costs and long term operation and maintenance.
* And in these uncertain times we need to mitigate future financial risks - future risks to our investments. Whether it’s a down payment on our first modest home or an organization funding big commercial building projects - buildings are huge investments, typically our biggest investments. Today, with fast changing environmental and regulatory conditions these investments face an increasingly uncertain future. How do you lower your risk today? Build a Passive House.

Passive House cuts through the twists and turns and gets you over the horizon, to the goal line. We’re headed to a zero carbon future. With Passive House we can build to meet that future today. With Passive House you can future proof your buildings.

A goal of this short presentation is for you to better understand what this all means and how it’s all possible. Understand how you can utilize Passive House to make the change you want to see in the world.

We hope you'll never be able to look at buildings the same way again.

5 [PREHISTORY]

So let’s first take a step back, what came before Passive House? What’s the prehistory?

6

Of course Passive House didn’t spring from out of nowhere - it was formulated based on a long history of efforts.

Not surprisingly, like so much received wisdom, it starts with vernacular architecture. And the example of Southern China is of particular relevance because it was the study of the performance of these buildings that helped inform the work of Bo Adamson, a Swedish academic, and launching the Passive House idea for a research project in Europe.

Another interesting example is the Norwegian Polar explorer ship, The Fram - which contained all the principle strategies of Passive House building - with fresh air, and the occupants comfort provided by only a single lamp burning.

In Denmark the DTH zero-energy house provided valuable experiences directly incorporated into the start of Passive House research.

In Germany a super-insulated experimental home showed the potential of passive measures providing energy savings on the order of 10 to 20 times, in Europe and America.

And in the US and Canada, pioneers like Wayne Schick, William Shurcliff, Amory Lovins, Harold Orr and others pushed super-insulated developments in the 70s and 80s.

These and many more examples were the precursors of the birth of the modern Passive House.

We should note here as a clarification sidebar of sorts, that none of these precedents were what we’d call Passive Solar buildings, that proliferated in the 1970s. These precedents are not over-glazed and rely more on a balance achieved with super-insulation. It’s understandable that people mistakenly draw a direct connection between Passive Solar and Passive House because of the similarity in name and use of passive solar heat gains, but the connection causes endless confusion and wrong-headed assumptions.

Personally, I’d compare it to someone confusing an electric golf cart for a Tesla automobile. They have their similarities, but occupy different realms of development and considerations.

7

So, the first Passive House was built in 1990 as a research project, a physics experiment, in Darmstadt Germany by an international team led by Dr. Wolfgang Feist, the founder of the Passive House Institute and included the pioneer Bo Adamson and many others. It was, and is, composed of four attached row houses, complete with custom building components developed for the experiment. And this research solidified the underlying principles and strategies that would become the Passive House Standard.

The story goes that Amory Lovins visited the building and provided the insight that these new developments could be standardized and scaled to great effect on the building industry.

And from that time the Passive House Institute has continually conducted research and developed tools, working with industry and government partners worldwide, to make passive house buildings the new normal.

8 [DISCOVERY - flipping the equation slide]

So what changed, what was the discovery of this Passive House experiment. What flipped in our thinking?

9

What came out of this research was the essential power of the passive house concept.

Traditionally the focus is first on efficiency alone, and achieving comfort and health in spite of energy efficiency. Efficiency geeks would see efficiency as first order of business and the other benefits as secondary. But with Passive House this thinking is turned on its head.

With Passive House the focus on occupant comfort and health first and it is this focus on comfort and health that drives performance, that drives efficiency. Passive House starts with the occupant.

Per the purely functional, shall we say Platonic or idealized definition, as it was distilled. We quote:

“A Passive House is a building, for which thermal comfort (ISO 7730) can be achieved solely by post-heating or post-cooling of the fresh air mass, which is required to achieve sufficient indoor air quality conditions – without the need for additional recirculation of air.”

This describes maintaining comfort and health with 100% fresh air with a very low capacity for heating and cooling energy. You need a very energy efficient building to achieve this.

Consequently, health, comfort and efficiency are all working in the same direction - all supporting each other.

So we have what’s really a comfort and health standard, producing an energy standard - the Passive House Standard.

10

This diagram shows homes, but it could be any type of building, with heat losses below the middle line of equilibrium and heat gains above the line. We could also flip this to be about cooling in a hot climate. In the old very leaky and modern, moderately leaky, shall we say, homes, large active heating systems are required to bring the building into balance - as the gains above must equal the losses below. While the Passive House building requires a tiny fraction of the energy to be brought into balance.

This dramatic reduction in heating and cooling demand demonstrates the power of the optimized passive architectural structure - we see that the building has done most of the work to bring the energy flows into balance and it is just topped off with active systems. This new reality will flip our expectations.

11

It’s a flip that we’ve experienced with our computer industry - where computers get ever more powerful, while using much less energy. And so too Passive House decouples power from performance.

Passive House provides a clear pathway to decouple, and frees us to deliver zero-carbon buildings today.

This is game-changing. Let’s look at what Passive House delivers.

12

The Passive House concept starts with the occupant, as we’ve said, and moves outward.

What makes us comfortable? How about, Steady temperatures, no drafts, no cold feet. Peace & quiet. How about sitting by the window on a cold winter day and feeling comfortable.

13

Passive House provides hygienic indoor air quality - 100% fresh air and exhaust, with no recirculation. It’s filtered fresh air - keeping pollution out. No mould and associated illnesses - reduced asthma and allergies.

14

Passive House provides resilience - that we can shelter-in-place indefinitely in the winter. And in the summer for an extended period - long enough for the power company to get things up and running again.

This example is from a home in Brooklyn, New York, several Polar Vortexes ago. The black line is the exterior temperature diving down and staying freezing for four days. The red line is the interior temperature - it’s not a flat line but steady and we see the one moment when the family turned on the heat during the week.

15

Passive House supports equity by delivering high-quality, comfortable and healthy homes that cost dramatically less to operate. The dramatic reduction in energy usage also protects people from possible future energy price shocks. This is an affordable housing development for seniors in Queens, New York, that also has a pre-k school on the ground floor.

Passive House first scaled in Europe with affordable housing projects, and today in the US we see affordable housing advocates incentivizing and encouraging Passive House building.

16

Passive House supports our country’s transition to a green grid and electrified future. The dramatic energy reduction Passive House buildings provide makes removing fossil fuels from buildings economical. And with renewable energy options available on-site and off-site, Passive House makes grid utilization more efficient and resilient.

Consequently, the more Passive Houses we build, less renewable production is ultimately needed, making our green transition more affordable and more quickly achievable.

17 [Think & work differently slide]

To achieve the wide range of benefits a Passive House building can provide, Passive House doesn’t look to more power first to solve problems. Instead, as designers and builders we re-engage the passive building elements, the architecture, the structure itself, and empower it to do the heavy lifting.

As you would first place the fulcrum of a lever in the optimal position to lift a weight before applying power to lift it, in our case, think of the enclosure as the fulcrum. And how we formulate the enclosure, like the placement of the fulcrum, has an equally profound effect on the power needed to provide comfort and health.

This flips our business-as-usual thinking. Consequently, Passive House does make us think and work differently.

18

Passive House asks us to question everything. To effectively restart - like going back to the ancients. How do we optimize and empower the passive building elements to do this heavy lifting?

19

And this goal, this quest of unlocking the power of the passive building structure re-engages our focus with the ingredients, the recipes, the materials, the details, and the craft of building. It empowers and energizes the project team from the owners to designers to builders and construction site laborers alike - nothing and no one is taken for granted.

20

And this quest for passive building power has us designing and building with the energy flows and the energy balance - not as far off abstract concepts, but instead as active tools that inform everyone’s work.

21 [Do we have the imagination? slide]

And once we’ve decided to grapple with the idea that our architecture can produce such profound and far reaching results, the challenge is really a simple question: Do we have the imagination? Do you have the imagination it takes? Don’t be **deceived** by what you may or may not think is possible.

22

Passive House is just starting. And like the stone master builders of medieval times - who could have imagined that working in stone, they could develop the flying buttress, they could effectively dematerialize the walls. It was an astonishing transformation. Certainly, it was at one time, unimaginable.

23

Today, Passive House is evolving rapidly - so let’s move the frame of reference - let’s look at towers - and shake our preconceptions about what is a Passive House building and what might be possible.

From left to right: a bank headquarters in Vienna, then a midtown Manhattan high-rise mixed affordable and market rate apartment building, then a 60 story residential tower starting construction in Vancouver, and on the right, a mixed-use high-rise under construction in Boston. Not your typical Passive House.

24

And even more so, here is a garment factory in Sri Lanka, a retrofit of the existing old factory no less, and Passive House Certified.

25

And of course, there is housing - This is an affordable housing development in Norwich in the United Kingdom, that won the Royal Institute of British Architects highest award, the Sterling Prize - so here we have affordability, performance and architectural design that is recognized, all in one package.

So with those few examples I hope we can shake off any of our residual self-imposed artificial limits on what’s possible.

Passive House is no more a constraint to great design than any other programmatic element you're tasked with delivering.

26 [How much does it cost? slide]

But beyond imagination, we should also address, up front, the very real, and concrete concern about cost. After all, it has to be affordable to be successful, right? So how much does it cost?

27

And here we have to change our thinking too.

Passive House is not an add-alternate in the bidding process - if it’s seen as an add-on, it will fail.

Passive House is not an “upgrade” - this too will doom it in the project. Instead, Passive House is a fully integrated approach, a fundamental programmatic item - it is the only way to succeed.

And to be clear, making a Passive House building is not about making the cheapest building. This is high-quality construction, made to last. But it is about affordable high-quality.

And as a fully integrated goal, experience shows that the Passive House related decisions can actually drive down costs as much as they might raise costs.

In fact there are so many other decisions in a given project that have a much greater impact on the ultimate project cost - Passive House shouldn’t break the budget, it should fit in your budget.

Let’s note that this graph demonstrates the lack of direct correlation between Passive Houses, the blue dots, and non-Passive Houses, the black dots - and cost. In these examples Passive House was not an add-on but an integrated goal, and it shows the average cost of the Passive Houses to be less expensive!

I don’t know all the decisions made but clearly optimization in the designs and construction are driving affordability.

However, let’s not count on Passive House buildings being cheaper - after all we don’t eat as nutritiously as we should, and we don’t exercise enough either, at least most of us - and so let’s not assume we’re going to optimize our Passive House enough - it’s life, right? So let’s aim for affordable. Not the cheapest, maybe even a bit more…. and what we’re seeing is that a 3-5% increase in project cost from a reasonable baseline can be expected. If the increase is greater than 5% then the decisions need to be re-examined, as something went off the rails in the design and decision making process.

Let’s say a few brief words on staying on budget. To stay on budget Passive House must be included at the very conception of the project. Not introduced in CDs or DD or even in schematic design. Passive House must be included in the pre-design programming work.

You really must work with a Certified Passive House Designer, and preferably the building certifier, from the beginning - so you can benefit from their institutional knowledge. Don’t dig a hole on day one that you have to then later get yourself out of.

Require the team of professionals and builders to have proper, Passive House training. The engineer and architect should be Certified Passive House Designers too and the builder should be a Certified Passive House Tradesperson. Passive House expertise is needed to optimize effectively in the project process.

And optimize from the start and stick to getting certified. Stick to the target.

And if team members are feeling like something is just too tough or seems impossible - it could be that a lack of experience and known references is inhibiting them. Get them to reach out, find examples and experiences around the world, they are out there - because while Passive House is young, there is a world of experience to benefit from. The global Passive House community is generous in sharing information - use it. We can’t be islands and succeed.

And let’s be clear, if you are diligent and eat your spinach and run those laps, you can come in at traditional building cost or maybe even be less expensive.

28 [HOW IS THIS POSSIBLE slide]

Easier said than done, right? It may seem impossible on its face. I mean, how can you be at cost parity or close to cost parity and have all these amazing benefits?

29

Predictability is the key. You can fully optimize the performance and the economics if you have a strong sense of predictability. If you can calculate accurately and execute to a clear plan.

So the Passive House Institute didn’t just give us this new concept and say, hey, go to it, good luck - but instead, provided a pathway, a methodology, and a wide and growing number of tools to enable predictability.

Building certification is critical but there is much more to it.

There are component certifications of essential components like windows and ventilation units - be sure to check out the database of thousands of certified components on the Institute’s website.

And critical personnel certification - on the design and construction sides.

The PHPP energy model is an active tool in the design of the building.

Reference materials abound from the Passipedia, the building database and other corners of PHI’s vast website.

And PHI conducts ongoing cutting edge research around the world, with new uses, new climates, new typologies and new methodologies.

The Passive House Institute has over 60 employees from all over the world - many of them not just building scientists, engineers or architects, but physicists - it’s an extraordinary brain trust that you have the opportunity to work with.

And the knowledge is widely shared through many channels including the International Passive House Association, of which NAPHN is a part. The peer-to-peer global knowledge sharing network may be the most powerful aspect of all.

30

It is also possible because the pathway includes very clear certification targets, with metrics that include comfort, health and energy. These are not relative targets, set to a baseline that can be gamed, but hard targets that leave you knowing where you stand. Today, the targets include increasing levels of renewable energy production integration, and greater efficiencies - buildings built to be future-proof.

31

The certifications also extend to retrofits with the EnerPHit standard - also including higher levels of performance and renewable energy integration. EnerPHit provides flexible pathways including a step-by-step strategy that allows for phasing of work in sync with the replacement cycles of the building systems, ensuring that Passive House performance is the end result.

32

We mentioned the building certifiers earlier in relation to controlling costs and the importance of their role cannot be overstated. We are fortunate to have 13 independent certifiers operating in the United States today. They work cooperatively, sharing experiences and information with each other - and the certification process from day one of your project is critical to making success normal.

And a side note but an important one. We see today more and more buildings claiming to be Passive House buildings or they are advertised as being built using Passive House principles - be sceptical. We see these buildings that are alleged to be Passive House buildings, falling short of owner expectations. So buyer beware. If the building is not certified, is not certified by one of these certifiers, your risk of not meeting your targets, your risk of producing a gap in performance, can go up significantly.

33 [How do you make a Passive House building slide? slide]

You may now be saying to yourself - okay...that’s all well and good but how do we actually do it.

Alright, it’s time to dive in.

As we’ve noted, we need to re-engage the passive building elements, the architecture, the structure itself, and empower it to do the heavy lifting. Reclaim the power of the architecture.

34

The Passive House Institute provides an integrated methodology that organizes the work, and keeps you on the path. The methodology focuses initially on the enclosure, then ventilation, and *lastly* on active heating and cooling.

We’ll look at the role of insulation and thermal bridge free connections. A thermal bridge is where there is a break in the insulation and heat can more easily escape - like a cold metal window frame in winter. We’ll look at airtightness, high-performance windows and doors with solar protection, and high-efficiency heat recovery ventilation.

There is more to it of course, but these are the key ingredients or principles.

35

These key areas and more, are all entered into the Passive House Planning Package or PHPP, energy model.

The PHPP is an Excel based tool which allows the designer to simulate the behavior of the building both during ‘peak’ times - winter and summer - and over an entire year. This flexible, easy to use model allows for quick iteration and design alternate evaluation.

The PHPP and all other simulations should be implemented not just as ‘Compliance’ tools – to demonstrate that the building meets the standard – but as ‘Design’ tools which allow the team to iterate and evaluate a host of ideas and options, real world assumptions and possible future scenarios. This doesn’t mean that the PHPP ‘controls’ the design, but rather that it helps to ‘inform’ the design with performance data throughout the process. This is the essence of data-driven design. Of good design.

36

With that let’s take a closer look at the ingredients being entered into the PHPP, starting with the first, Right Sized Continuous Insulation. Generally this means more insulation than normal - but not always.

37

The idea is that you want to insulate to a level where you don’t just shiver less but you are actually comfortable. Typical buildings are like an underdressed teenager, wearing nothing but a hoodie in mid-winter - they’ll survive but do we want to live like that? You know that if you wear the right layers, and a good parka and hat and so on, you can not just get by in the cold but actually be warm and comfortable. Our Passive House is the same way.

Or think of it as a temperature rated sleeping bag - all surrounding the conditioned space.

38

Principle #2 then extends this thinking to make sure we don’t have breaks in the insulation. In typical construction, thermal bridges may not seem important in isolation, but they can completely undermine the building’s performance. If we think of a thermal bridge as a cut - your project can easily die from a thousand thermal bridge cuts, if you’re not very careful. If thermal bridges are not controlled, meaning minimized or eliminated and then calculated in the PHPP energy model, the resulting uncertainty will mean that you can’t really optimize the HVAC system - it will be a bad building.

39

Examples of thermal bridges abound - the thermal image on the lower right shows the common balcony connection turning the building into a radiator to the world. A thousand cuts. The colder interior surfaces can cause condensation as we see on the window frame at the upper right and mould on the left. To overcome them, typically we overheat, treating the symptom with brute force. With Passive House we avoid the problem in the first place.

40

Thermal bridges typically occur at junctures - where the floor meets the wall or wall meets the roof, or at window frames meeting walls, or balcony connections. The energy loss causes thermal discomfort, and condensation, and moisture damages. Traditional energy models don’t account for thermal bridges and is big a contributor to the oversizing of mechanical systems - as they say, “you know, just to be safe.”

Again, in Passive House, we look carefully at all these connections and junctures, work through the construction details and eliminate the thermal bridges entirely, or minimize and calculate them. We include them in our PHPP energy model. This results in increased predictability and produces lower risk, holistically optimized construction.

41

Principle #3 is an airtight enclosure. And while when the subject comes up people might reflexively touch their necks and worry about poor indoor air quality, and perhaps succumb to nightmarish imaginings, of not being able to open windows. We need to set the record straight at the start.

Two concepts are in play - quality indoor air and our freedom. And so we need to flip the common and wrong-headed thinking, on both.

First let’s address quality.

The fundamental idea at work here, is that it is very difficult to control the quality of something, if you don’t first have control of the thing itself. If the enclosure is leaky the polluted outdoor air is moving willy-nilly through the building. Consequently, the only way to have any sense of control is to overcome it with power - never sure if this space or that space is properly ventilated. Like thermal bridges we’re treating the symptoms with more brute force.

But in an airtight environment, the air is under control and we can then very efficiently and confidently maintain its quality. Airtightness sets the table for healthy indoor environments.

But you say, that’s all well and good - but the Passive House police won’t let me open the windows. The reality is quite the opposite. Of course there are no Passive House police. And you can, in fact, open the windows.

But let’s think about it, let’s think about when and why you open windows. You often open the windows when the indoor environment feels unhealthy and uncomfortable - and you NEED the fresh air.

It’s not a want, it's a need.

But in a Passive House you have clean fresh air whether the window is open or closed. You don’t NEED to open the window. You open a window because you choose to. It’s a lovely day - open the windows and let the breeze blow through - how nice. Passive House, counterintuitively, is actually giving you the freedom to choose.

42

So with that set straight, let’s take a moment to talk a bit more about why airtightness is so important. Airtightness is so important because it profoundly affects so many fundamental aspects of building performance.

We’ve just spoken about it supporting indoor air quality. What about comfort?

Well, it eliminates those annoying drafts, drafts we need to overcome with enlarged mechanical systems. More brute force treating symptoms, rather than preventing the problem in the first place.

Airtightness also protects the enclosure from moisture damages. It is not generally understood or appreciated that air moving through the enclosure leaks can carry massive amounts of moisture with it producing another source of rot and mold and is a leading cause of building damage insurance claims. So by making the enclosure more airtight, we reduce moisture damage risk, and we increase durability.

And airtightness radically reduces heat loss. If we take two buildings, both well insulated equally but one is leaky and the other airtight, the difference in heat loss could easily exceed a magnitude of 5 times. 5 times the difference! - they become totally different buildings based on airtightness alone.

And so if in your energy calculations, design and construction, you can confidently provide greater airtightness, don’t just hit Passive House airtightness go hit twice the airtightness (that first Passive House in 1990 did) and you can eliminate lots of insulation. Another powerful “a-ha moment” is the realization that teams that are proficient in providing airtightness, can achieve huge enclosure cost optimization, construction savings, and greater design flexibility.

In hot/humid conditions or climates, airtightness keeps the humidity out and reduces the demand for dehumidification, allowing the cooling system to be sized mostly for cooling, as it should be.

Finally, where air leaks, noise also travels. If you are in a noisy environment - in the city or in the country - Passive House airtightness delivers peace and quiet. You can hear yourself think again.

For all these reasons, the truth is, that a building can never be too airtight and Passive House takes full advantage of this truth. Airtightness is a Passive House superpower that you can make your superpower.

43

#4 High-Performance windows & doors with solar protection.

The flip here, as we spoke in the beginning, is to rid ourselves of the unfortunate association people make with past Passive Solar buildings. And we must always be on guard to avoid overglazing and the accompanying overheating. The Passive Solar buildings of the 1970 and onward were overglazed, out of balance, and often uncomfortable.

Let’s be clear too that Passive House buildings don’t have tiny windows either, we’re not building caves. Expansive views and abundant daylight are typical in Passive House buildings.

We will utilize passive solar heat gains, as the windows can be designed to be a substantial part of our heating systems - but we are doing so while also being very conscious about the energy balance, about providing solar protection and the consequences. Restraint might be a good word for what we’re showing off.

44

A key concept here is that the windows and doors act not simply as a provider of views and daylight and a provider of passive heat gains, but they are a critical component in our continuous insulation and airtightness layers.

The windows themselves are often triple-pane, and truly thermally broken and airtight with three layers of gasketing typically.

And the window connections to the surrounding construction, the connection to the surrounding airtight and insulation control layers must be airtight and insulated - thermal bridge free connections, of course. This all gets you deep into the construction details, into the connections and the power of those details.

Passive House windows can come in any type - metal, wood, metal-clad wood, pvc and fiberglass. There are dozens of suppliers to the US market today and there are several North American manufacturers producing Passive House Certified units. Be sure to check out the Certified Component database on the PHI website, passivehouse.com.

45

Window quality is a primary driver of comfort. And while there are a myriad of factors, the fundamental idea here is that our typical windows result in significant temperature asymmetry - in winter the window is colder than the other room surfaces and you feel it. It causes convective currents and this needs to be overcome with perimeter mechanical systems. The common sad refrain of more power treating symptoms.

With Passive House, the windows are of a quality that their temperature is close enough to avoid discomfort and avoid the need for mechanical systems to compensate. Because windows are such a critical component and their performance cannot be compromised we recommend that Passive House Institute certified windows are utilized.

46

Like airtightness high-quality, high-performance windows disproportionately affect the overall energy balance performance of the building - they offer greater design freedom, flexibility and options. They provide value that cannot be appreciated in an isolated budget line.

47

And while windows provide our views and daylight and yes, useful passive heat gains - improperly designed windows can cause significant overheating, resulting in discomfort and additional air-conditioning requirements. And we know that overheating is a common problem in conventional buildings across the country today.

The best approach to avoiding overheating is to carefully provide proper shading. Shading can be provided by how the window sits in the wall, an architectural element or landscaping. Needed shading can be achieved with interior blinds but exterior shading is the most effective. Shading cannot be an afterthought. Solar shading cannot be optional.

48

#5 High-efficiency heat recovery ventilation. Let’s recall back to the platonic definition of Passive House - a primary goal was to ensure effective hygienic ventilation.

Today, in coping with the COVID-19 pandemic, hygienic ventilation is a hot topic. Add to that the inescapable forest fire smoke and the long history of poor health outcomes for marginalized communities on the fence line of industrial production - of course hygienic ventilation should be a foundational goal.

49

And remember, also, that what is going to set us up here for success is the airtight enclosure. There’s no pollution entering willy-nilly as happens in typical construction - we have control of the interior air.

Now, typical buildings have ventilation systems, just bad ones, often providing only intermittent exhaust from bathrooms and kitchens that don’t ensure good ventilation everywhere. And in commercial buildings, the ventilation system often includes a lot of recirculated air.

In a Passive House building we supply 100% fresh air to every served space: the bedrooms, living rooms, offices, classrooms and so on… and 100% exhaust from every service area: the bathrooms, kitchens, utility areas etc… operating continuously 24/7.

The systems are all laid out to ensure that all spaces have robust ventilation.

Again, there is zero recirculation.

Now such a system of 100% air changes would normally be prohibitively expensive to operate - because typically you need to heat or cool that fresh air to maintain comfortable interior conditions. But this gives us the passive in ventilation - because there is a passive heat exchange element located with the fan unit, that allows the heat and energy from the outgoing airstream to move to the incoming airstream. And today the efficiency of this passive exchange can exceed 90%. This means that on a cold winter day the fresh air supply, without any added heat enters the room within just a few degrees of the room temperature, ensuring occupant comfort.

And Passive House Institute certified ventilation units ensure that you get the performance and cost savings you expect.

50

In looking at the energy balance of the building and the building design, we are also going to look at things that provide internal passive heat gains as well - the people, appliances and equipment, the lighting and mechanical systems - because they can contribute significantly to providing the heat needed in winter and unwanted heat in the summer.

It all goes into the PHPP energy model.

51 [Active Heating, Cooling….slide]

So at this point in moving through the building design, the metaphorical fulcrum is pushed as far as it can go - the architectural design and other passive elements are doing the heavy lifting.

Like the gothic cathedral the architecture is doing the work again, we’ve minimized the need for active heating and cooling and dehumidification, but depending on where you are, there will likely be a need for active heating, cooling and maybe even dehumidification.

It’s important to remember that this is about optimization, not magic tricks.

52

So what we might typically see is the ability to meet the occupant needs with a 75% reduction in mechanical equipment sizing and up to a 90% reduction in usage.

Perimeter heating and cooling and radiant floors are not needed for comfort. We can pull the distribution to the core of the building, shrinking it and giving space back to the occupants. And because the loads are so low, electrifying the heating along with cooling is economical.

We can get rid of hydronic heating if we like and provide heating and cooling from a single heat pump system.

The only trick here is perhaps getting the mechanical engineer to agree with the plan. Because at first glance they might see a building that will fail - I mean, how could it not with such a small mechanical system? It can take a few meetings. But with careful explanations, even engineers who we’ve seen initially energetically opposed, can become ardent supporters. We need all you engineers out there on board. We can’t do it without you.

53

And then there are smart systems. Passive House isn’t opposed to incorporating smart systems and technology - even the first Passive House had a CO2 detector to help control proper ventilation - but the smart systems should enhance high-performance. Smart systems should not be used to compensate for poor performance.

Too often today, because architects have forfeited their power, massive and complex mechanical systems are employed that require expensive ongoing management. Some architects see these systems as enhancing their power to design. It’s not true - they’ve given up their design power.

With Passive House let’s make the architecture do the work again.

Then, and only then, let’s incorporate the most efficient equipment and let’s add smart systems as we like - but always with an eye toward greater simplicity. Let’s simplify, simplify and simplify. Our resilience depends on it.

54

So, this methodology we’ve described has global applicability - it is being applied all over the word - and the basic principles have local solutions. We are grappling with global crises, and we can all work together, around the world, learning from each other - to address them.

55

So let’s end here with another look around at the great variety of Passive House buildings underway. Some more examples.

In China Passive House is exploding - here is an example of a guest hotel for a company south of Beijing. Today in China entire new Passive House districts are being built.

56

In the UK in Exeter - they are building a municipal leisure center with big indoor swimming pools. Today, in Exeter, the city builds everything to Passive House standards, affordable housing, schools, administrative buildings, and now a leisure center.

57

And the Congo is not a place you might necessarily expect to find a Passive House building, but Belgium could be. So when the Belgian government planned their new embassy, they made it a Passive House.

58

Grimshaw Architects designed this stunning academic building at Monash University in Melbourne. A Certified Passive House.

59

Sophisticated affordable housing in Philadelphia - that is net zero from onsite renewables.

60

And here is a single family scale building, although it’s a retreat for musicians, truth be told, in Southern Vermont. It’s beautiful in setting and balance.

61

And it shows that a modest building, in a tough climate, can be filled with light, have great views and serious architectural expression. We can have it all, we just need to imagine it and work for it.

62

So as the world heads toward climate tipping points and we plainly see the interconnections of these crises - Let’s have the imagination and determination to seize the inherent power of building, and really leverage it - so that we can confidently deliver better health outcomes, support greater equity and deliver climate action proportionate to the emergency at hand.

We see the push to zero carbon emissions on the horizon, across the board, and coming at us fast.

Let’s not wait another day, but instead, let’s set ourselves up to meet that world, by building Passive House buildings now.

63

So, are you thinking differently? Are you ready to act? Let’s get to it!

I hope to see you at future NAPHN Passive House trainings and events. Thank you.