

Making Passive House Mainstream

Chris Corson says someone has to elevate American housing—and he's ready for the job

BY PATRICK McCOMBE



This past spring, I arrived at the Ecocor shop in Searsmont, Maine, shortly after work had started for the day. I'd come to learn more about Ecocor, a construction firm startup founded by Chris Corson that builds panelized, superinsulated Passive Houses. I first learned about Chris in 2012, when his intelligently designed Passive Houses were coming in at half the cost of other site-built Passive Houses. As I walked around his expansive shop, snapping photos of the eight-person crew assembling panels for a 2400-sq.-ft. custom home that would later be shipped to and assem-

bled in Nashua, N.H., I couldn't help but wonder what the 25,000 sq. ft. of shop and warehouse space were costing the company. On the Swedish-built assembly tables were five panels in various phases of construction, and the place was spotless and well organized. Chris arrived shortly after. Seeing that his down jacket had been repaired with European air-sealing tape, I had hope we could talk over beers later.

After some niceties, I asked Chris if the state of Maine had given him tax incentives or low-interest loans for what looked like millions of dollars worth of manufacturing equipment. He told me he was



READY TO ASSEMBLE

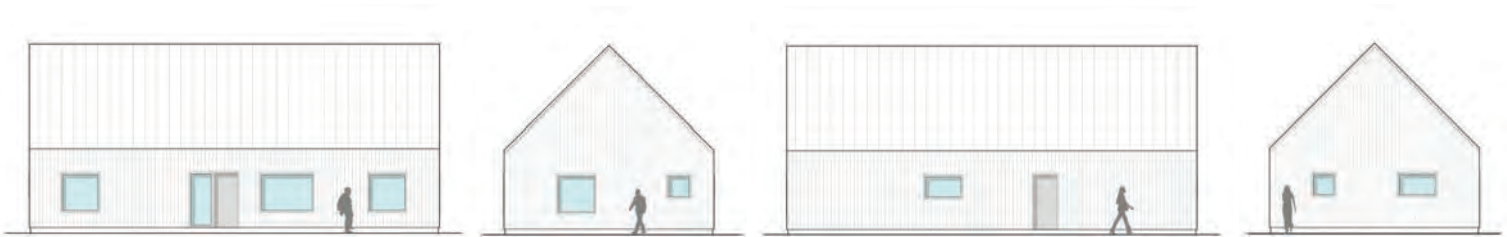
With a plan to bring superior insulation and superior comfort to the masses, Chris Corson starts each Ecocor Passive House as panels built in a Maine factory that can then be shipped to and assembled on any job site. Sales are good and the company is on pace to complete its 40th prefab home by the end of the year.

entirely self-financed and that he had always been good with money. He added, “Well, really I can do this because my wife lets me.”

I then asked him why he would risk building a factory and incurring so much overhead for what amounts to a very expensive niche product. He reminded me how hard it is to frame a house during Maine’s brutal winters and how construction slows to a crawl for three or four months. He also talked about how tough it is on a framing crew to shovel a foot of snow off floors and roofs just so construction can continue. He pointed out that even during warmer months,

regular rain makes a typical construction site a muddy mess. He told me that by building panels indoors, he can produce a weathertight shell in days or weeks, instead of months.

But improving workflow efficiency and working conditions for his framing crew are only two of his reasons for moving production indoors. Corson, who has studied environmental issues since college and whose wife consults internationally on fisheries management, describes climate change as the single greatest threat to the planet and its population: “The built environment is responsible for approxi-



PASSIVE HOUSE MADE TO ORDER

Ecocor offers 11 model homes in its Solsken Collection, in sizes from 218 sq. ft. to 2316 sq. ft., with prices spelled out clearly on the company's website (ecocor.us). Delivery and shell-assembly costs depend on how far the job site is from the company's headquarters in Searsmont, Maine. Ecocor also builds custom homes using the same roof and wall assemblies and construction methods found on standard models.



MODEL GOLDENROD

PRELIMINARY PRICING

Ecocor Shell

- Raft slab foundation
- Exterior wall panels
- Interior walls and doors
- Ventilation system
- Roof
- Air-sealing and insulation
- Windows and doors
- Siding and exterior trim
- Equipment rental
- Travel and transportation costs
- Consulting costs

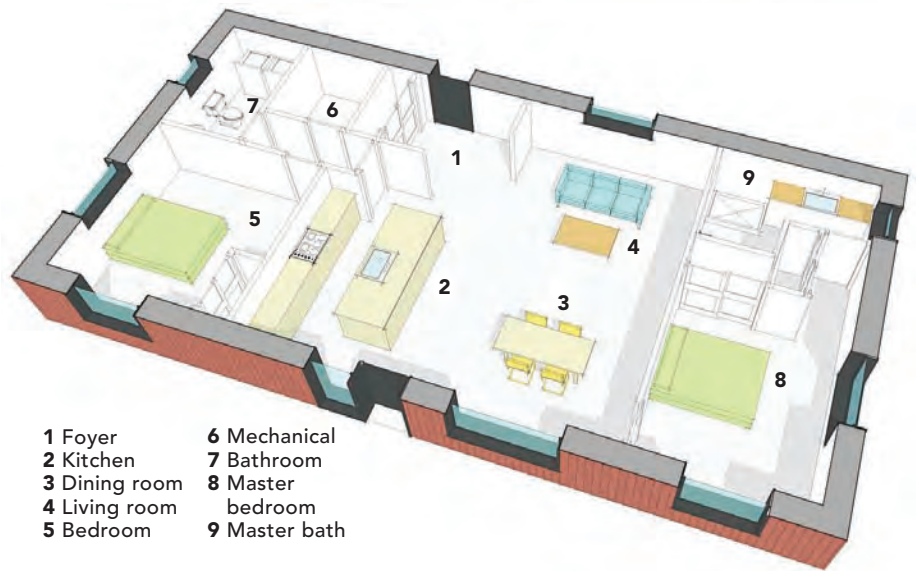
Subtotal \$222,807.99

Elements provided by others

- Concrete and rebar
- Standing-seam metal roof
- Interior finishes
- MEP and miscellaneous costs
- Ventilation system installation

Subtotal \$107,270.40

Total \$330,078.39



- 1 Foyer
- 2 Kitchen
- 3 Dining room
- 4 Living room
- 5 Bedroom
- 6 Mechanical
- 7 Bathroom
- 8 Master bedroom
- 9 Master bath

REGIONAL PRICING



MODEL	SIZE	DETAILS	MAINE	NEW ENGLAND	MID-ATLANTIC	GREATER U.S.
Goldenrod	Exterior: 1431 sq. ft. Interior: 1192 sq. ft.	Bedrooms: 2 Bathrooms: 2	\$330,000	\$343,000	\$349,000	\$355,000



mately 50% of global carbon emissions annually. American housing is a big part of the problem and somebody has to elevate it. Why shouldn't it be me?" Through his business, Corson says he's creating jobs, impacting climate change, and selling high-quality housing at an affordable price, and from my perspective he's put his money where his mouth is.

Ready for growth

With a factory capable of cranking out a home every day when it reaches full capacity, Corson figures he can sell more homes over a wider geographic area and therefore have a greater positive impact on climate change. Currently, the shop can make between three and five panels daily, depending on their complexity, but Corson thinks that his three assembly lines could produce two to three times that amount as demand increases.

The Ecocor wall assembly is based on a conventional 2x4 wall sheathed with Zip System sheathing and tape. I-joists are used like Larsen trusses on the exterior to contain a thick layer of dense-pack cellulose insulation.

The assembly is more complicated to build than other superinsulated designs I've seen. When I asked him why he doesn't add a layer of exterior foam to a conventionally framed wall, a strategy common to many superinsulated houses, he answered matter-of-factly: "Foam is toxic—the main ingredient in polystyrene is a carcinogen. Foam burns and off-gasses. Cellulose is inexpensive, safe, and has the lowest embodied energy of any insulation. You can't burn it, and its borate fire retardant keeps away insects and rodents.

"It also has excellent moisture-management properties, taking on and releasing moisture with the seasons, which keeps wall and roof assemblies at a uniform moisture content," Corson continued. "We've been monitoring three Maine projects for several years. Hygrothermal data logging has shown that the sheathing stays at 8% moisture content."

Even though the outside layer of the panel, described by Corson and his crew as the blanket layer, is covered with almost 12 in. of blown cellulose, the structural 2x4 load-bearing wall on the interior is conventional in many respects. It includes jack studs, headers, and open stud cavities (later insulated on site) for roughing in pipes, wires, and mechanicals. Plus, its conventional 2x4 construction doesn't scare local building inspectors or subcontractors who may be unfamiliar with double-stud walls, structural insulated panels, or OVE framing.

The panels are adapted from the wall and roof assemblies used on the five Passive Houses Corson's company built on site (before they switched their approach and started building them in the factory). Early projects used regular commodity OSB panels, but they've since switched to more expensive Zip System sheathing. "We had one project early on where blower-door testing revealed that conventional OSB was slightly air-permeable, enough that we couldn't meet the Passive House standard of 0.6 ACH50. On that project we had to coat the interior side of the OSB sheathing with a spray-applied WRB to make the material sufficiently airtight."

The wall panels leave the factory with wood-framed triple-pane windows and doors bought directly from the manufacturer in Poland. They're generally installed in the center of the wall, where Corson feels they offer the best balance of aesthetics and energy performance. The windows are waterproofed with multiple layers of flashing tape and integrated into the Solitex Mento Plus WRB that covers the insulation. The Mento is stapled to the I-joists with upholstery staples, spaced so closely that they nearly touch. Then the staples and seams are taped with Tescon Vana tape.

European housing is the model

Corson told me that his motivation for panelizing houses was inspired by several trips he took to Northern Europe for his wife's work. "Scandinavians build nearly all of their housing indoors. I toured factories that are building high-quality, high-performance housing that doesn't cost a fortune." He also claims the quality of his factory-framed housing is better than site-built homes because the tolerances are much tighter.

"When we build panels on the framing table, there's no eighth of an inch of slop," he says. "Everything is framed and sheathed perfectly."

His expectation for precision carries into the field work. Field supervisor George Reefer—who supervises site assembly and manages production—is responsible for getting the subslab EPS foam insulation positioned before a concrete sub places the concrete slab foundation. (While he doesn't use it on the wall panels, the EPS foam is part of the subslab insulation.) The foam layer—high-density, borate-treated blocks made locally for Corson—is both insulation and formwork for the thickened-edge concrete raft slab. Reefer told me that early on they tested the insect resistance of this particular foam by placing it on a large nest of carpenter ants behind Corson's garage. He said the

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FACTORY BUILT

Ecocor's 25,000-sq.-ft. shop includes three panel-assembly lines. The wall and roof panels are designed using CAD software and the cut lists for individual panels are sent to an automated saw that cuts the lumber components. When an individual panel is completed, it's stood upright and placed on a steel rack before it's moved to covered outdoor storage.



Time-saving smart saw. Armed with a nearly 28-in.-dia. (700-mm) blade that can cut through an I-joint in about a second, Ecocor's Randek saw has a computer-controlled stop and software that keeps track of the cut list.



Ready to roll. As a wall or roof panel's parts are cut, they're placed on a rolling scaffold. When all the parts are ready, the scaffold is moved to the front of the assembly line and the individual components are made into a panel.



Traditional construction inside. To comply with prescriptive elements of residential building codes, Ecocor's wall panels start with a conventionally framed 2x4 structural wall sheathed with Zip System.



Thick insulation outside. I-joists used as Larsen trusses create a cavity to hold a nearly 12-in. layer of cellulose insulation, which eliminates thermal bridging and makes Ecocor homes extremely quiet and comfortable. Window and door openings are surrounded with 7/8-in. engineered rim board for fastening the company's European-made flange-free windows and doors.



Fill 'er up. Once the framing is complete, the exterior is wrapped with Solitex Mento Plus, a breathable WRB. The wrap is held in place with upholstery staples and the seams are taped. Then dense-pack cellulose insulation is blown into the I-joint cavities through a series of 4-in. holes, which will be taped over later.

ants crawled over it for three years, but never damaged it. The only result was some yellowing from UV exposure.

Corson wants the foam set by his own crews instead of subcontractors because the site-built foundation must marry up perfectly to the airtight, factory-made panels. Once the foundation is in, Reefer and his four-person crew assemble the shell. Most homes can be erected with Ecocor's articulated telehandler, but larger homes will sometimes require a crane provided by a local subcontractor. Once the shell of the house is erected, if it's within about 40 miles

of their shop, Corson's own crew will finish it. Otherwise, the rest of the construction is then handed off to a local general contractor to finish.

As I was watching Reefer and his crew assemble the Nashua house shown in the photos, I said to him, "You guys have this figured out. You get to do the fun part of the build and somebody else has to finish it."

He replied, "I know, it's cool. It also allows us to focus on the part we do best."



Machine muscle. Each panel weighs between 600 lb. and 1200 lb. and must be handled with machinery. Double beads of Contega sealant on the foundation and between the wall and roof sections stop air leaks. Panel joints are also taped for air- and weathertightness.

FIELD ASSEMBLED

Once the raft slab foundation is complete, the panels and the company's rotating telehandler are sent to the job site using one of several trucking companies contracted through a freight agent. A five-person crew—a foreman, two laborers, and two riggers—assemble the shell, starting with the longest wall. Keeping quality control top of mind, Corson's crew does its own blower-door testing, ensuring the completed shell is sufficiently airtight.



Anchors act as hold-downs. Simpson Titen HD anchors spaced every 2 ft. hold the wall panels to the slab foundation. The 1/2-in. holes are made with a rotary hammer and the anchor is tightened with a 1/2-in. impact wrench.



Structural screws join panels. GRK structural screws join the panels to each other and to the beams and posts. Wood cleats screwed to one of the studs where the panels join help correct any misalignment at panel edges.



Plumbing and bracing. Adjustable steel bracing from Qualcraft makes it possible to plumb panels and keep them safely upright. 2x10 boards at grade level allow for more-flexible mounting locations, and the steel form pins that support the 2x10s easily penetrate rocky soil.



Panels make framing different. Unlike typical platform framing where beams supporting the floor system are installed ahead of the joists, here the floor panels are temporarily supported until beams can be screwed to the panels.



Roof panels install like floor panels. Roof sections are constructed and fastened similarly to floor sections, except they contain a cellulose insulation layer like the wall panels. A double bead of Contega sealant stops air leaks at top plates.

When Corson and I met for beers after my day at the factory, I said, "You strike me as the type of guy who likes to go his own way. Why a strict German efficiency standard?"

Corson answered right away: "I like that it's based on science. I believe in science, and prefer to listen to people who know what they're talking about, like scientists. The overwhelming majority of scientists say climate change is real. The Passive House standard is what's needed for housing to have a positive effect on climate change. I also like that the standard is performance based, not prescriptive. As

long as you can achieve the performance requirements, you can meet them in any way you want."

Of course, Ecocor isn't the only company that has chosen to build modular high-performance housing. But if the enthusiasm and work ethic of its founder and crew can get similar enthusiasm from home buyers, it will be one of the leaders that determine the future of home building. □

Patrick McCombe is an associate editor. Photos by the author.