United Therapeutics
A PUBLIC BENEFIT CORPORATION

MANUFACTURING IN A TREE HOUSE: Integrating Net Zero with Nature-Based Design

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Americans spend about 30 percent of our lives working inside buildings. Greener and healthier buildings are designed at least in part to better address the health of their occupants, and there are many studies that draw positive links between green buildings and health impacts.[1]

UT employees, whom we call *Unitherians*, tell us they value working in our sustainable facilities, which we believe is just one of the reasons our retention rates are so high.[2] We also recognize that using less energy, and building with materials that have lower overall embodied carbon,[3] enhance our resilience in the face of potential disruptions related to climate change.

Stairwell in a building on the Silver Spring, Md. campus

But there's another reason why we undertake these kinds of projects: *we like to do things that others may think are impossible*.

"We shape our buildings; thereafter they shape us."
Winston Churchill
Statesman and former Prime Minister of the United Kingdom

As we recognize the 55th anniversary of Earth Day on April 22, 2025, and the 53rd anniversary of World Environment Day on June 5, we'd like to take a moment to review our latest sustainable facility project, called ***Warp-10***, to explore how we are expanding the boundaries of what is possible in sustainable construction.

This article outlines the design and requirements of the mass timber, cGMP[4] pharmaceutical manufacturing facility at our Research Triangle Park, N.C. (**RTP**) campus. It also discusses how our Corporate Real Estate (**CRE**) team integrates biophilic design elements, which incorporate nature's elements and principles into built environments to improve well-being and create more harmonious spaces. Finally, it emphasizes the importance of striving for net zero operational and embodied carbon and why trying to get there is almost as important as actually achieving the goal.

THE IMPETUS BEHIND *WARP-10*

"Warp speed ahead, Mr. Spock."

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[1] MacNaughton, Piers, et. al. "The impact of working in a green certified building on cognitive and functional health." March 2017. Science Direct. Vol. 114, pages 178-186. Accessed April 16, 2025. https://www.sciencedirect.com/science/article/pii/S0360132316304723

[2] UT's turnover rate has consistently been below our industry average, at 4.6 percent in 2024 compared to our peers at 11 percent. Industry data from Aon/Radford Turnover study; 2024 data published December 2024 | U.S. Life Sciences: Biotech/Pharma | Date range for 2024 industry data is June 2023 – June 2024.

[3] A net zero energy site is one that is optimally efficient and, over the course of a year, generates at least as much renewable energy as it consumes on that site. Site net zero energy and site net zero operational carbon are equivalent. A site net zero embodied carbon building is one where total carbon emissions produced in the production and construction process stages of a building lifecycle, including emissions from raw material supply, manufacturing, transportation, and construction or installation of a building, are reduced to zero. https://worldgbc.org/thecommitment/commitment-glossary/

[4] cGMP = current Good Manufacturing Practices. These are manufacturing practices and controls that ensure that manufactured products are consistently produced and controlled according to set quality standards.

If you are a Trekkie, this quote needs no explanation. For everyone else, warp drive was the fictional technology in *Star Trek* that enabled the *Starship Enterprise* to travel faster than the speed of light. In the *Star Trek* universe, warp factor 10 represents infinite velocity, a theoretical limit where the ship would exist in every point in the universe simultaneously.

It's considered an unattainable maximum rate of speed, i.e., impossible.

Back down here on earth, the driving need behind the construction of this unconventional pharmaceutical manufacturing facility goes back to our highest purpose at UT—to create a brighter future for our patients.

In May 2022, we received U.S. Food and Drug Administration approval of our therapy **Tyvaso DPI®** (treprostinil) inhalation powder. Since commercial launch, we have been able to produce sufficient supply of product to meet demand through our collaboration with MannKind Corporation. Still, one of our public benefit corporation (**PBC**) objectives is to "leave no patient behind", which compels us toward our robust inventory goals for our products. This was also the goal behind the construction of our LEED Gold *Phase Five* warehouse and logistics center, also in RTP. Considering our inventory objectives and anticipated future growth in demand for the product, the need for a manufacturing facility for Tyvaso DPI becomes clear.

When patient needs are at the fore, we move fast. But we are also committed to "operate sustainably", which in implementation terms can potentially take more time and expense. It is this "impossible" dual ambition that is behind the new facility we call *Warp-10*.

THE DIRECTIVE

Every construction project we undertake at UT starts with a list of top requirements. For *Warp-10*, UT Chairperson and CEO, **Dr. Martine Rothblatt**, shared these with the CRE team:

- Establish manufacturing capacity to meet Tyvaso DPI projected growth and inventory needs;
- Strive toward net zero operational carbon (otherwise known as net zero energy);
- Strive toward net zero embodied carbon;
- Do not exceed the budget; and
- Construction complete in Q4 2026.

Unlike other greener building projects, this project required equal attention to all five priorities. "In some projects, Martine has established a clear hierarchy of project needs, which has helped the project team make quick decisions and keep the project moving forward," explained **Andy Campbell**, Associate Corporate Real Estate Director and project lead for both *Phase Five* and *Warp-10* projects. "But for this one, Martine challenged us to hit all five objectives. And that's what really makes this project fit its name."

THE DESIGN

Warp-10's cGMP space will comprise about 80,000 square feet. The site will house full upstream and downstream manufacturing processes—from pharmaceutical manufacturing to fill-finish, device assembly, and kitting. Outside the manufacturing space, the building will house a warehouse that will include ambient and cold storage with a refrigerated loading dock. In addition, another of our PBC objectives, to "be a destination employer", means we always incorporate at least one wellness room, which is available for nursing parents, a kitchen, and other amenities areas for team members to socialize.

Warp-10 design rendering

To make progress toward the project's net zero energy requirement, the CRE team emphasizes what UT can do to mitigate our impacts onsite. While UT has about 4-MW of solar capacity on our RTP campus already, this facility will need its own source of renewable energy. For this reason, *Warp-*

10 will include a new photovoltaic (**PV**) array of more than 6 million kBtu, which translates into about the amount of capacity needed to power almost 167 average American homes over the course of a year.[5]

Many of the building attributes—including onsite solar—are like a handful of other leading pharmaceutical manufacturing sites. So how is this facility going to be different?

Let's talk about timber and biophilic design.

What is mass timber?

"Mass timber can be a few things. In total, they are engineered wood products that are created by attaching smaller pieces of wood together to create larger structural elements," Andy explained. "Basically, a building that uses engineered wood as a primary load-bearing structure is considered mass timber."

The value of using mass timber depends on its use case but can include among following benefits:

- Projects can run about 25 percent faster[6] when using mass timber versus conventional construction materials because mass timber is prefabricated and ready to use on delivery;
- The wood used is sustainably grown and harvested, and the carbon sequestered in the wood when the tree was growing is retained within, which reduces its overall carbon footprint compared to conventional materials;
- The material is strong, performing as well as concrete in events like earthquakes while weighing about one-fifth less;
- Buildings can be built up to 18 stories high;
- The material is fire resistant; and
- The materials contribute to biophilic design.

According to one recent count, there are about 2,500 mass timber projects under construction or built and in operation in North America as of March 2025.[7] Of those, just under 50 are identified as industrial. To our knowledge, there are no other mass timber pharmaceutical facilities in the U.S.—or the world. "The construction and pharmaceutical industries are both very risk averse," Andy explained. "That often leads to reticence to try new things. At UT, we are all about trying new things that are important to our purpose, asking 'why not' if someone says something can't be done. And, in doing this work, we help create a roadmap of possibility. Our partners will have experiences from which to draw, and other biopharmaceutical firms will have an example of something innovative that has worked elsewhere—and professional design and construction partners who can do the work."

What is biophilic design?

A recent scientific literature review on the impact of nature on human health found demonstrable evidence of improved physical and cognitive health outcomes in patients treated with nature-based interventions, such as outings in nature or other access to the natural environment.[8]

While not among the top priorities for the building, UT's CRE team has always been intentional about the wellness elements of our spaces. "Most *Unitherians* spends a lot of time in our buildings," **Thomas Kaufman**, Associate VP of Corporate Real Estate said. "Incorporating art into our spaces has always been important here. We also know there are links between nature and health. So, for example, we've built green roofs and living walls into various spaces. Daylighting has always been an important feature in our buildings. More formally integrating biophilic design principles into our processes just make sense."

Stephen Kellert,[9] a professor of social ecology at the Yale School of Forestry and Design, helped establish the practice of biophilic design with a six-principle framework:

1. Environmental features: incorporating natural elements like water and natural materials;

[5] According to the most recent estimates by the U.S. Energy Information Administration, the average annual electricity consumption for a U.S. home was 10,791 kWh (https://www.eia.gov/tools/faqs/faq.php?id=97&t=3). 6 million kBtu is approximately equivalent to 1.8 million kWh. 1.8 million kWh /10,791 kWh = 166.8.
[6] Brinson, Staci, Esq. "Why mass timber on the rise." *AXA Insurance Reinsurance*. Oct. 1, 2024. Accessed April 16, 2025. https://axaxl.com/fast-fast-forward/articles/why-mass-timber-is-on-the-rise
[7] Source: WoodWorks, a mass timber industry association. https://www.woodworks.org/resources/mapping-mass-timber/
[8] Nejade, Rachel, et al. "What is the impact of nature on human health? A scoping review of the literature." *Journal of Global Health*. December 16, 2022. Accessed April 14, 2025. https://jogh.org/2022/jogh-12-04099
[9] https://www.researchgate.net/publication/321959928_The_Practice_of_Biophilic_Design

2. Natural shapes and forms: incorporating botanical motifs, spirals, arches, and curves into design features;
3. Natural patterns and processes: incorporating fractals, blending materials that are static with those that change over time;
4. Light and space: daylighting, or designing to take advantage of natural daylight, and using varied lighting to mimic outdoor spaces;
5. Place-based relationships: using local materials and native planting to integrate with the local environment and avoid the "placeless-ness" often associated with industrial buildings; and
6. Evolved human-nature relationships: recreating sensations from nature, such as awe, excitement, protection, refuge, exploration, and discovery.

Warp-10 is being designed to reflect many of these principles. "Like the art in and around our buildings, the design is not meant to convey an overt message or force anyone to really think about it," Thomas said. "What people experience in the space will vary, and likely will be subtle on any given day, but it is certainly also going to be a beautiful building that we hope our colleagues will enjoy being in during their workdays."

THE JOURNEY TOWARD NET ZERO

Warp-10 is being built to serve a critical need for our business. It is also a demonstration project of extraordinary ambition.

Like any building project, the team must consider trade-off decisions. Patient-centricity drives them to prioritize schedule and capacity to produce product. However, sometimes material choices to achieve net zero embodied carbon can conflict with a net zero energy (operational carbon) goal. For example, the pursuit of energy efficiency can lead to the use of more insulation materials which themselves may have higher embodied carbon.[10] As the grids decarbonize, operational carbon associated with energy use will go down. Building operators also have more interventions available to drive down energy consumption after a building is in operation, unlike embodied carbon, which is largely fixed based on design decisions up front. That means that embodied carbon becomes a bigger part of a building's overall footprint over time—and an increasingly important piece of a net zero carbon facility strategy.

Warp-10 is expected to obtain almost 40 percent of the energy it will need over the course of a year from its onsite renewable energy—still, an amazing feat. Meanwhile, the design, which incorporates mass timber, low carbon concrete[11], green steel, optimized insulation, and organic raw screen materials is expected to achieve our net zero embodied carbon goal for the building.

The true test of our estimation models will come when the facility is fully operational over time.

So, why take on this "impossible" ambition at all if we know we cannot achieve the site net zero energy target with onsite renewables alone?

We tackle *Warp-10* challenges not just for the sake of it, but to solve human problems. The stakes are high but to us, the potential benefits are higher. As **Ayana Elizabeth Johnson**[12] asked in the title of her bestselling book, *what if we get it right*?

United Therapeutics converted to a PBC in 2021—the first publicly-traded biopharmaceutical company to do so. Our **PBC purpose** has two parts: ***to create a brighter future for patients through the development of novel pharmaceutical therapies and technologies that expand the availability of transplantable organs.*** Our first purpose helps delay or avoid the need for a transplant, while the second purpose enables a patient to have a transplant when they need one. We align our PBC purpose and objectives with three pillars—our patients, our people, and our planet.

[10] Parkin, Anna, et. al. "Net-zero buildings: when carbon and energy metrics diverge." 2020. *Buildings and Cities*. Volume 1, Issue 1. Pages 86-99. Accessed online April 18, 2025: https://journal-buildingscities.org/articles/10.5334/bc.27

[11] Concrete is the second most widely used building material, but one of its key ingredients, Portland cement, has a sizable carbon footprint; *green concrete* partially replaces cement with other materials, significantly reducing the embodied carbon of the concrete. *Green steel* production uses renewable energy sources and innovative technologies in the steel-making process, thus reducing the carbon footprint associated with this material.

[12] Ayana Elizabeth Johnson is a marine biologist and policy expert whose book, "What if We Get it Right? Visions of Climate Futures" was on *The New York Times* best sellers list in 2024.