Hongene Biotech

# Global manufacturing and sustainability: Your questions answered

The market for nucleic acid therapeutics (NATs) is rapidly expanding, driven by new large patient population applications, such as high-prevalence cardiometabolic conditions. As demand for oligonucleotide drug substance is driven from kilograms to tens of tonnes, the environmental burden of traditional manufacturing approaches becomes difficult to manage. This creates an equally pressing need for responsible, sustainable practices while meeting such large-scale demand.

Vertically integrated supply models are designed to support sustainable practices by streamlining a traditionally fragmented NAT supply chain. Eliminating handoffs between vendors reduces transportation-related emissions and centralizes control over energy-saving practices in manufacturing facilities.

Below, we answer key questions about scaling vertical integration in NAT manufacturing to support sustainable practices, and explore how this model will shape the future of the sector.

01

## What does a vertically integrated supply model look like in NAT manufacturing?

Previously, NAT manufacturing has required developers to work with a fragmented supply chain, with each vendor responsible for individual processes such as providing raw materials, cGMP production and fill-finish. With each handoff of products and documentation, there is an opportunity for delays and misalignment.

Vertical integration is designed to address the limitations of fragmentation by bringing all of these specialist vendors together within a single company. This allows closer coordination across the manufacturing process and reduces reliance on external suppliers.

02

## How does vertical integration reduce transportation-related emissions?

In fragmented supply chains, materials have to be transported between multiple geographically distributed vendors, generating greenhouse gas emissions throughout the production process. By consolidating production stages within one company, vertical integration can reduce transport requirements and the emissions associated with them.

03

## What operational inefficiencies can vertical integration improve?

At each handoff between vendors, there is a risk of duplicate quality control testing, repeated technology transfers and additional packaging waste. As vertical integration eliminates the need for external handoffs, it minimizes waste and enhances process efficiency.

04

## How can facilities in vertically integrated models support sustainable practices?

Within an end-to-end supply CDMO partner, there is greater oversight and control over the production facilities. Consolidating operations enables manufacturers to institute targeted energy-saving measures, such as investing in solvent recycling, electrifying on-site logistics and using 100% solar-powered exterior lighting.

05

## How does chemoenzymatic ligation support sustainable practices?

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06

## How does vertical integration support the future of sustainable NAT manufacturing?

Meeting the large-scale future demand for NATs will require both lower-waste synthesis technologies and more integrated manufacturing models. More specifically, when combined with advanced approaches such as chemoenzymatic ligation, a vertically integrated supply model can help manufacturers scale production more efficiently while reducing environmental impact.

07

## How does chemoenzymatic ligation support sustainable practices?

Chemoenzymatic ligation is a next-generation approach for oligonucleotide therapeutics, designed to reduce reagent and solvent usage compared to full solid-phase synthesis (SPOS). This advanced approach is inherently high-yielding and scalable, meaning less waste is generated. A vertically integrated supply model supports the scalable execution of this sustainable technology by consolidating the in-house production of starting materials and ligase.