CUSTOMER CASE STUDY

Samsung C&T de-risks green plant design with integrated dynamic simulation

Samsung C&T Corporation - samsungcnt.com
Industry - Engineering and construction (EPC) / Energy (renewables, green hydrogen and ammonia)

Challenges

- Intermittent and unpredictable renewable generation drove constant changes in electrolyzer load and downstream ammonia synthesis conditions, increasing operability risk in early-stage designs.
- Hourly energy modeling supported cost and capacity optimization but could miss minute-scale transients, such as ramp limits, control response, and transport delays, that influence reliable operation, safety constraints, and achievable production.
- Interactions across power supply, electrolysis, energy storage, hydrogen storage, and long-distance pipeline transport created design “blind spots” that were difficult to validate with steady-state methods alone.

Solutions

- Samsung C&T built an integrated dynamic model in AVEVA™ Process Simulation to connect renewable power and Battery Energy Storage System (BESS) behavior with electrolysis, hydrogen storage and pipeline transport, and downstream ammonia synthesis, so it could validate early design assumptions under realistic transient operations.

Results

- Increased total hydrogen production by approximately 2% by refining BESS control logic to better use surplus renewable power.
- Identified transient drivers behind production shortfalls versus hourly energy modeling, including ramp-up/ramp-down effects, electrolyzer performance at part load, hydrogen venting events, and non-optimized BESS utilization.
- Flagged hydrogen storage and transport constraints that could lead to venting at the pressure limit and delayed feed response to downstream ammonia synthesis, supporting earlier corrective design decisions.
- Improved predicted annual ammonia production from 951,269 t/y (dynamic base case; –4.87% vs 1,000,000 t/y target) to 1,003,194 t/y (dynamic improved case; +0.3% vs target), representing about a 5.1% improvement between dynamic cases.

AVEVA

Samsung C&T is a major South Korean engineering, procurement, and construction (EPC) company delivering large-scale power and energy projects. As green hydrogen and ammonia concepts move from ambition to engineering reality, Samsung C&T has been evaluating how to design plants that can meet production targets while operating safely and reliably under variable renewable generation.

As part of its commitment to clean energy, Samsung C&T developed a concept for a renewable-powered green hydrogen–ammonia plant targeting 1,000,000 tonnes per year of ammonia production. The concept integrated wind and solar power with a Battery Energy Storage System (BESS) and a large electrolyzer system for hydrogen production, followed by hydrogen storage and long-distance transport via an 80-kilometer pipeline to support downstream ammonia synthesis. However, the plant's upstream energy supply and downstream process constraints operate on different time scales, meaning a design optimized at an hourly planning level may risk minute-scale operability issues, control limitations, and avoidable production losses during ramps and transients.

"Dynamic simulation allows us to model the real-time operation using smaller time steps and more details of equipment behavior, control systems, as well as the process interactions. With this, we can verify whether the plant is operable, reliable, and safe."

-

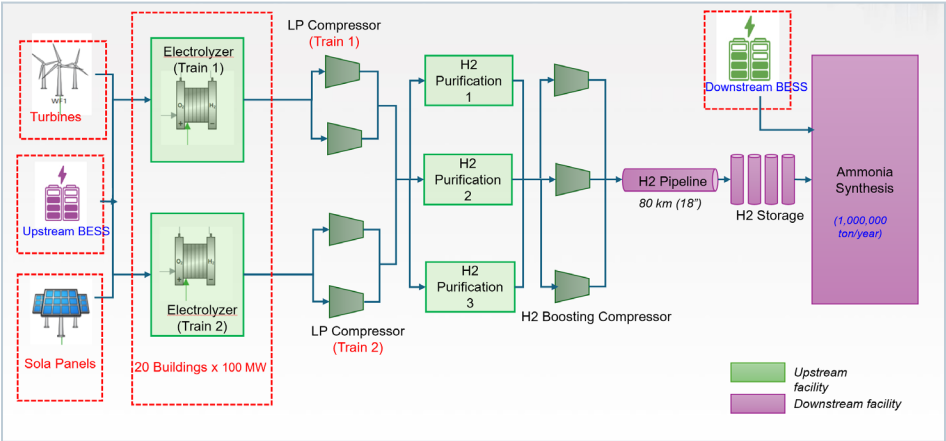
Supaporn Wilailak
Process Engineer, Power & Gas Engineering Team,
Energy Solution Division, Samsung C&T

Designing for variability and transient effects

Renewable variability can propagate through the full hydrogen-to-ammonia value chain. Changes in wind and solar output affect electrolyzer load and hydrogen production, which in turn influences hydrogen inventory and the stability of feed to ammonia synthesis.

Samsung C&T found that hourly energy modeling is effective for early feasibility and capacity trade-offs, but it can miss minute-scale effects that materially influence operability, such as ramp-rate limits during start-up and turndown, controller response, inventory dynamics, and delays introduced by long-distance transport. By layering in dynamic simulation, Samsung C&T could assess these transient behaviors early, providing a clearer basis for decisions on control strategy and equipment sizing before design assumptions became more expensive to change.

In response, Samsung C&T opted to complement hourly energy optimization (useful for early feasibility and cost trade-offs) with minute-by-minute dynamic simulation in AVEVA Process Simulation. The combination of hourly optimization and dynamic simulation enabled Samsung C&T to test whether the integrated system could operate as intended under changing renewable conditions—and to identify where control strategies, storage sizing, or operating logic needed refinement before key design decisions were locked in.



Integrated model scope: renewable power, BESS, electrolysis, hydrogen storage and transport, and downstream ammonia synthesis.

Modeling the complete renewable-to-ammonia system

Samsung C&T developed an integrated dynamic model in AVEVA Process Simulation that represented the combined renewable energy system, energy management and storage, electrolysis-based hydrogen production, hydrogen storage and pipeline transport, and downstream ammonia synthesis. The team modeled the full system within a single simulation environment so it could quantify how decisions in one area (such as BESS operation) propagate into hydrogen availability and downstream process stability.

Key modeling elements included:

- **Electrolyzer performance versus load:** Stack performance curves captured changes in efficiency and hydrogen output during transitions and part-load operation.
- **High-resolution setpoints derived from energy optimization:** Hourly targets from the energy model were converted into smoother setpoint trends for transient ramp-up and turndown analysis.
- **Multi-unit electrolyzer cluster control:** The model represented approximately 2 GW of capacity across 20 individual 100 MW units, including sequential start/stop logic, ramp-rate constraints, and startup/shutdown timings.
- **BESS charging and discharging logic:** State-of-charge behavior and curtailment logic evaluated how storage could smooth power fluctuations and stabilize electrolyzer operation.
- **Hydrogen storage filling/emptying logic and pipeline delay:** Tank controls and an 80-kilometer pipeline model captured storage behavior and transport delays affecting ammonia synthesis feed.

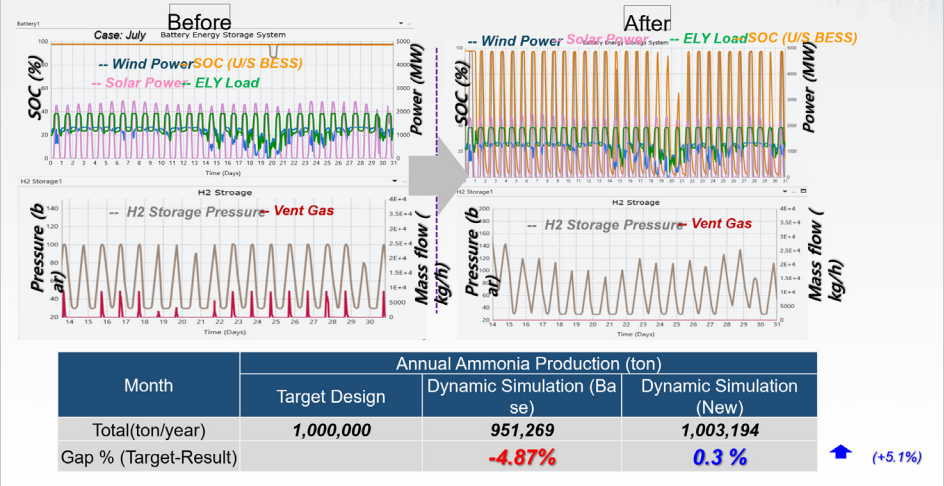
> "Even with limited early-stage data, we were able to develop the model with support from AVEVA experts."
>
> -
>
> **Supaporn Wilailak**
> Process Engineer, Power & Gas Engineering Team, Energy Solution Division, Samsung C&T

Why dynamics matter for production expectations

Samsung C&T used the integrated model to test annual production expectations under real operating conditions. The dynamic base case revealed several factors that reduced production compared with the initial energy model, including ramp-up and ramp-down behavior, electrolyzer part-load efficiency, hydrogen venting, and underutilized battery storage.

The analysis identified opportunities for improvement. By refining the BESS strategy to discharge at night and recharge during peak hours, Samsung C&T maintained a higher, more stable electrolyzer load while increasing hydrogen production by 2%. Dynamic modeling also exposed hydrogen storage constraints and pipeline storage delays that were not fully captured in the initial sizing approach.

With these insights, Samsung C&T made adjustments to operating logic and battery and hydrogen storage capacity. The result was a 5.1% improvement in modeled ammonia production—from 951,269 tonnes per year to 1,003,194 tonnes—moving the design from 4.87% below the 1-million-tonne target to 0.3% above it.



Month	Annual Ammonia Production (ton)		
	Target Design	Dynamic Simulation (Base)	Dynamic Simulation (New)
Total(ton/year)	***1,000,000***	***951,269***	***1,003,194***
Gap % (Target-Result)		***-4.87%***	***0.3 %***

(+5.1%)

Example results: production comparison and impact of improved BESS utilization and hydrogen storage behavior.

"AVEVA Process Simulation provided the capability to simulate the entire plant—from power sources to chemical processes—within a single tool. This made it possible to study transient behavior across the integrated system."

-

Supaporn Wilailak

Process Engineer, Power & Gas Engineering Team, Energy Solution Division, Samsung C&T

For Samsung C&T, dynamic simulation became a practical bridge between cost-optimized concept planning and design decisions that need to stand up to operational reality. By testing equipment constraints, control strategies, and storage and transport behavior at minute-scale resolution, the integrated model helped the company identify where production could be lost and where strategy or sizing changes could recover it, before those assumptions are embedded in downstream engineering.

Citation:

Wilailak, Supaporn. "Dynamic modeling of a green hydrogen-ammonia plant with AVEVA Process Simulation." Presentation deck at AVEVA World 2026

© 2026 AVEVA Group Limited or its subsidiaries. All rights reserved.
AVEVA and the AVEVA logo are a trademark or registered trademark of AVEVA Group Limited in the U.S. and other countries.
All product names mentioned are the trademarks of their respective holders.