How much gas will be available tomorrow?

SIH26200 · AICTE/MIC Student Innovation · Software

Innovative ideas that help manage and generate renewable / sustainable sources more efficiently.



Owner-provided photograph of our farm biogas plant

The operator’s challenge

A gas reading leaves key questions unanswered: feed history, sensor faults and future supply.

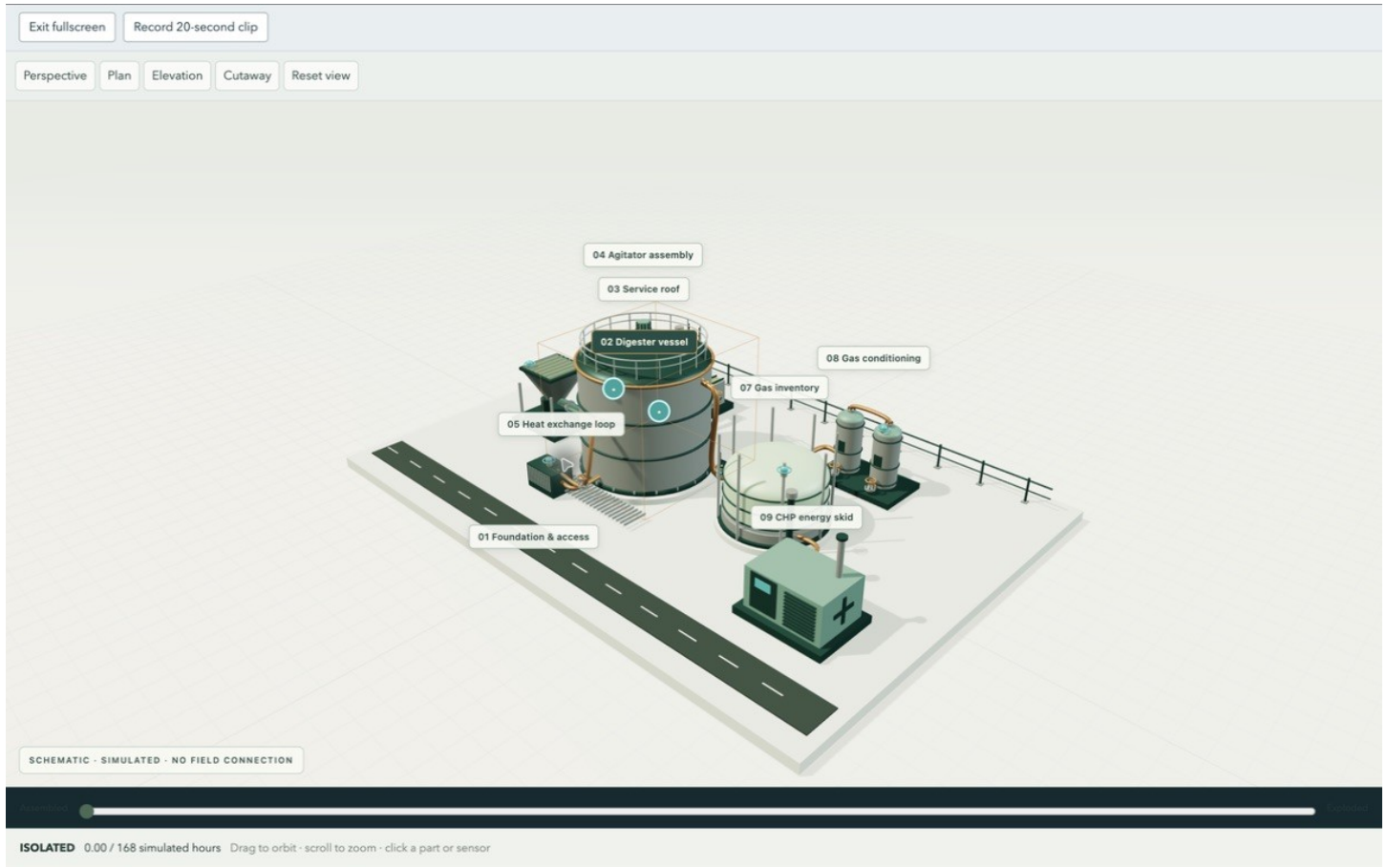
Our response

Connect plant history, forecast comparison and a visible digital twin to an inspectable decision.

Team GFIS EcoTwin · Shri Siddheshwar Women’s Polytechnic, Solapur

3D PLANT & PROCESS SOFTWARE

Plant assembly and a separate gasification module





Gasification process

Thermochemical equipment view.
Separate from biological digestion.

Student development: ROS2 data adapter, asset-state mapping and fault/replay tests

GFIS architecture: data, learning, physics and replay

RESEARCH PIPELINE · measured historical data

Traceable sources

Plant, time and units
Biogas / methane
Dataset ID retained

Past-only data

Missing-data flags
Train-only transforms
Lags / sequences

Model comparison

Persistence baseline
XGBoost lag features
LSTM sequences

Forecast evaluation

Time folds + seeds
MAE / RMSE
Final-period test

SIMULATION PIPELINE · explicit scenario assumptions

Scenario inputs

Feed and temperature
Demand and storage
Declared parameters

Physics checks

Gas / storage balance
Capacity and flow limits
Feasibility flags

3D plant + city

Three.js shared clock
48-hour scenario
Assets and alerts

Run memory

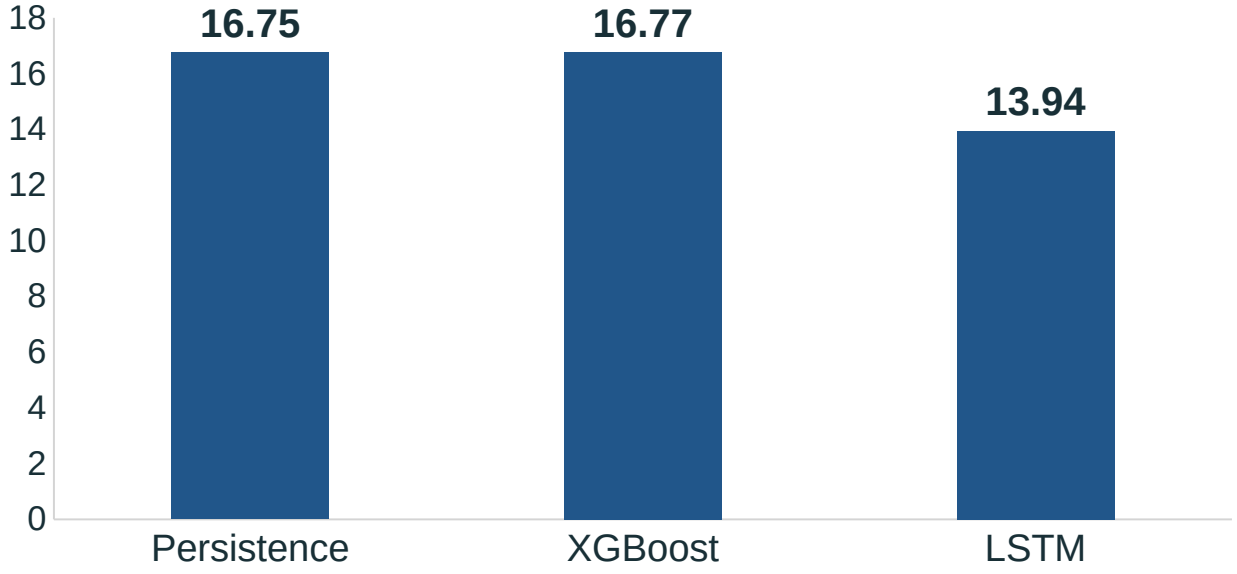
Config and outputs
Timestamped events
Replay / export

Student extension: farm inventory → ROS2 packet adapter → quality checks → twin-state mapping

Python research + AWS API/memory + Three.js interface. Farm integration is proposed; model paths remain separately evaluated.

We compare models before choosing one

24-hour mean total-biogas forecast



500,400 minute records · one Iowa facility
3 rolling folds · 3 seeds · LSTM: 15 epochs/fit
Fold SD: 5.24 / 6.34 / 4.31 CFM

16.8%

lower mean rolling MAE than persistence

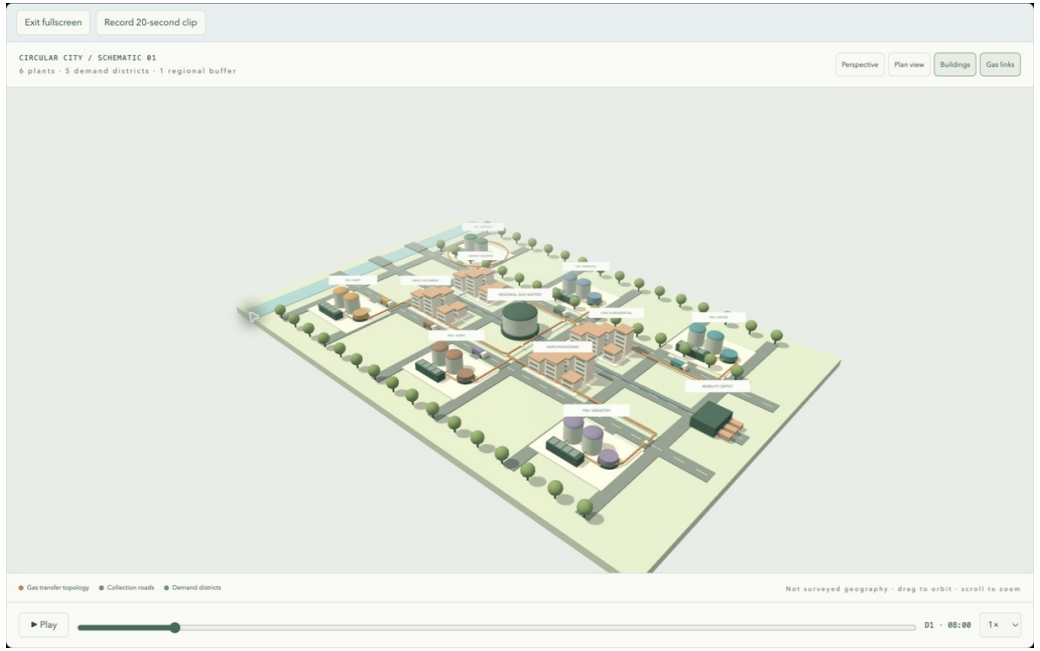
Final-period result

XGBoost 14.84 vs LSTM 15.33 CFM.
Model ranking changes with the period.

Validation discipline

Chronological splits and train-only transforms.
Sparse methane task: persistence wins.

From one plant to a coordinated energy scenario



Working city scenario + 48-hour synthetic plant run

Inspect demand, storage, outages and event history.
City flows are assumed; farm measurements are next.

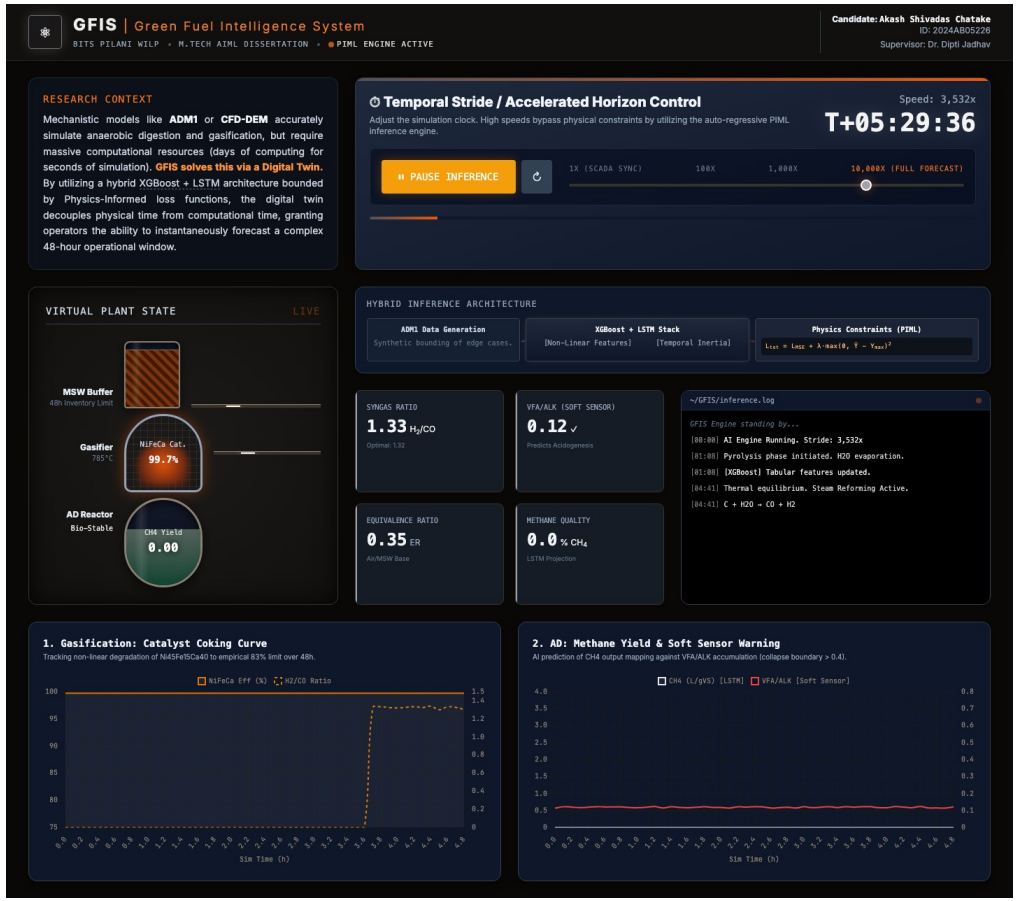
Fourteen-day student build

DAYS 1–3	Define packet schema and farm inventory
DAYS 4–7	Build ROS2 adapter and map twin state
DAYS 8–10	Test sensor faults, reconnect and replay
DAYS 11–14	Measure results and rehearse the demo

Pilot success measures

Forecast error · useful alerts · replay consistency
Net energy and savings require measured inputs.

Software test flow: scenario input to recorded response



01 Configure the scenario

Set feed, temperature and a 48-hour horizon.

02 Execute and inspect

Advance the clock and inspect state, curves and logs.

03 Build the student integration

ROS2 packet adapter, 3D asset updates and fault tests.

04 Verify repeatability

Retain configuration and compare replayed outputs.

DEMO gfis.energy/upgrade/ LIBRARY gfis.energy/sih/

Historical prototype screenshot. Synthetic scenario, not plant validation.