ARTIFICIAL INTELLIGENCE FOR OPTIMISED GAS BLENDING

How to use Artificial Intelligence to better address gas blending challenges
Who is DCbrain?

Created in 2014, DCbrain is a European B2B SaaS Software provider, specialized in Artificial Intelligence.
Our INeS (Intelligent Network Solution) is built around a Digital Network Twin that leverages network asset and flow data.

The digitization of complex networks helps network operators address a wide range of use-cases including the forecasted gas quality, the simulation of new inflows or the optimization of assets.

Our goal is to support operational and strategic decision making to create more value from networks in a dynamic market facing multiple constraints but also many opportunities.

Our solution is field proven and used by gas TSOs and DSOs in France and Europe.

Visit our website www.dcbrai.com for more information.
Blending challenges for the Gas industry
The introduction of different molecules, such as hydrogen, into the existing gas system will require a lot of care and attention to ensure that such blending supports end users consumption needs. DCbrain provide digital AI solutions for grid managers to track hydrogen, biomethane, calorific values and gas quality to ensure that end users get the gas they need. These are just the sort of made in Europe climate solutions we need to deploy today to deliver on our target of climate neutrality before 2050.

James Watson - Secretary General at Eurogas

The Gas industry faces major challenges with new gas injections

Obtaining carbon neutrality in 2045 requires existing systems and infrastructure to manage increasing quantities of decarbonized biogas and hydrogen inflows.

The fact that these changes are just around the corner is clearly demonstrated by the EU objective to install 6 GW of green hydrogen capacity by 2024 growing to 40 GW by 2030.

The blending of gas with different calorific values, the corresponding traceability of energy origin and the dynamic character of inflows are challenges related to blending which companies like DCbrain offer solutions for to the industry according to Dr James Watson, Secretary General of Brussels based Eurogas.

At the same time the interconnectivity between gas and electricity networks (sector integration) and a tendency towards decentralized market dynamics increases significantly the scope and complexity of decision making for gas TSOs and DSOs, all within a rapidly changing regulatory environment.
Gas blending use case with AI
Introduction

At DCbrain we are convinced that the digitization of gas networks combined with artificial intelligence helps TSOs and DSOs to make faster and better decisions. The modelling of how blended gas propagates through networks opens a number of exciting new opportunities for dispatching, metering, allocation, balancing, planning and maintenance departments.

During the last couple of years DCbrain has worked on a number of use-cases where the blending of gases plays a central role. But before looking at these use-cases in more detail, we would like to elaborate a bit more on the concept of the digital network twin.

Creating digital network twins, lessons learned

A digital network twin is a digital representation of the network and essentially models the pressure drop and gas quality mix over time. To build such a network model, information is required from GIS systems to describe the assets, their location and how the assets are interrelated as well as information from SCADA systems containing pressure and flow data.

Based on the input data the DCbrain engine creates the network model using a technique called Hybrid AI which is based upon neural networks exploiting physical characteristics such as pipe rugosity, fluids behavior or pipe angles.

Without going into the technical details we would like to share herewith what we learned over the past years building digital twins for gas networks:

- The lack of data should not hamper starting a digital journey. On the contrary, even with limited or small data, artificial intelligence is perfectly capable of delivering surprisingly accurate results. Starting with a sub-set of the gas network is a perfect way to prove value to stakeholders.

- Although initial confidence in data quality tends to be fairly high the reality learns us that on many occasions there are missing relationships between assets for the simple reason that this information is not necessarily needed in SIG systems. Also there are often errors in the meters itself, changing meter calibrations or formulas that aggregate different meters that do not necessarily reflect reality.
Naturally the quality of the network model depends on the quality of the measurements. If the network model learns from erroneous data, the model will be flawed as well. The famous law “garbage in = garbage out” applies.

Errors can be corrected off-line (within the model itself) or even better by correcting the measurements itself. The visual detection of anomalies between forecasted and actual pressure and flows is an extremely useful way to help improve SCADA systems.

This brings us to an important point: a digital model has many advantages (fast to implement, flexible, powerful, cost-effective...) over traditional “bottom-up” simulation tools, but it takes a joint effort to improve the model. Creating trust and adoption by users is an essential element. And trust only grows gradually over time.

The time spent to prepare the input data and improve a network model is much more important than building the model itself, which is now pretty much automated.

Projects can be deployed both on-line and off-line, that is to say, deployed as a stand-alone solution (often outside the IT environment as a SaaS solution) or connected with real-time data.

Digital network twins are closely linked with forecasting. Since meter measurements are not aligned (physical locations, injections or consumptions, different reading frequency, automatic and manual meter readings etc.) creating a forecast model alongside the network model creates a very powerful combination.

In short the magic formula is:

**Network Model + Forecast + Trust = Value**
Gas blending use cases
In this chapter different business use cases are presented.

Differentiated invoicing for metering departments

The first use-case on gas blending is to calculate the gas quality mix at every consumption point to improve invoicing accuracy.

Regaz, a French regional DSO headquartered in Bordeaux with 3400 km of pipes, three pressure levels and 220 000 meters faced pressure from the regulator to distinguish natural gas from biogas injections. Instead of investing in chromatographs it was decided to invest in a digital solution build by DCbrain that calculates at the end of every day the percentage of biogas at any point in the network.

This information is used for differentiated invoicing and making sure that the energy bill reflects the actual amount of KWh delivered. It only took 6 months between the start of a pilot project to an industrialized solution.

Asset impact assessment for asset managers

It is also possible to calculate with a digital twin the impact of different gas quality. This is particularly important for future hydrogen flows, but the technique can also be used to score assets on ageing, depending on the ‘stress’ of excessive pressure for instance.

Network steering for dispatchers

The simulation capabilities of a digital network twin allows dispatchers to simulate how for instance dynamic hydrogen inflows will propagate through the network. Naturally the configuration of a network (including incidents) are the starting point of such simulations.

Although from the outside an average percentage of hydrogen is an important metric, dispatchers are much more concerned on hydrogen peaks that may affect not only network assets or the energy balance but may also have impacts on the service level agreements of large customers.
Optimized measurement investments for network capacity planners

Investing in chromatographs is a good way of collecting reliable PCS or Wobbe data, but it comes in at a large investment cost. An optimizer on top of a digital network twin can be used to inform a decision maker on the minimum required number of chromatographs and their location at different levels of uncertainty. The same use-case can be applied to DSOs to prioritize and optimize their smart-meter deployment strategy.

Sector coupling optimizations for network capacity planners

Sector coupling raises all kinds of challenges, complicating even more the strict analysis of the blending of gases. Among the additional levers influencing day-to-day decisions are:

- The upstream intermittent energy flows
- Energy storage on both centralized and local levels
- Arbitrage between electricity and gas networks

Blending decisions will be based on a complex mix of electricity market pricing, network quality of service, asset impacts and regulatory constraints.

Conclusion

A digital twin network model combined with artificial intelligences serves a wide range of use-cases related to gas blending. Digital solutions are uniquely positioned to cope with the increasing complexity facing gas networks, and particularly for hydrogen inflows and sector coupling.
DCbrain: Making Gas networks smarter!
**DCbrain created a new technology: Hybrid AI**

DCbrain is a software publisher dedicated to gas network operators. It combines relevant network data with artificial intelligence in order to optimise operating processes, consumption and make flows more reliable.

However, AI has its limits and will not be able to calculate everything if what it is asked deviates too far from what it has learned.

That is why at DCbrain we use hybrid AI. It is faster and thus allows us to test more scenarios and thus to evaluate the most relevant scenarios. It provides the same power as normal AI without the black box effect (which means that we no longer understand its reasoning). It is easier to recognise what it does with the physical models it has ingested. Moreover, the understanding of the network is done in real time thanks to data.
DCbrain: at the heart of the AI revolution

Key technology
- Smart high-volume data ingestion
- Smart Digital network twin
- Distributed forecast and anomaly detection
- Complex optimization

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INES, a very operational tool

The INES software is based on classic AI modules (Machine Learning, Deep Learning and Reinforcement Learning) which allow to learn / identify phenomena via data. But what is also important for our customers is our ability to quickly integrate this innovative technology into your processes and provide your employees with innovative functionalities:

- **Forecast**
- **Simulation**
- **Optimisation**

Our product INES - a smart layer that empowers your network:
Why work with DCbrain?

Software integration in less than 2 months

Cloud agnostic: we work with any cloud service

Hybrid AI: combination of network data with AI
White Paper conducted by DCbrain
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