# Development of an Ultra Simplified Toolkit for
# UGS Operators, Customers & Traders

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## Abstract

Since 2013, EDF has developed a cavern simulation tool through means of a hitherto non-typical combination of physical and statistical modeling methods. Encouraging precision has been obtained in both, PVT data history matching and forecasting. In 2014, the underlying developments have been presented at SMRI (San-Antonio & Groningen) in the field of this innovative PVT modeling approach as well as first extensions into gas plant process modeling and operation optimization.

This tool developed exclusively under Excel is presently used on site. It is an operator oriented tool with a close link to data taken from the UGS Digital Control System (DCS) in order to support the operator from weekly to intraday UGS management in the aim to quickly assess achievable performances and associated own gas & power consumptions.

On the bases of the above, questions arose whether further functions could be developed to support UGS customers, namely traders, in their gas stock market decision making. But, traders do not reside on UGS sites and have limited interest in (and access to) technical data. Their fast-track needs rather express around achievable gas power (MW) and gas energy (MWh) performances of the UGS asset at any time of the year while handling an intentionally reduced set of input data like gas in place, working gas and cushion gas volumes (GIP, WGV, CGV) completed with estimations of own gas and power consumption as would be required through gas nominations. Likewise, those forecasting exercises should be accompanied with alarms in case operational constraints are detected (for example need for injection in case of shortage of yearly minimum imposed average cavern pressure).

The present paper introduces developments that have allowed such extended functions of the initially DCS-connected operator support tool on the basis of simplified off-line models that keep combining statistics and physics. Of course, developing simplified tools, means to develop simplified programs/algorithms which are far from rocket science.

**Key words:** UGS operation, history matching, gas nomination forecasting, trading oriented off-line functions, non-linear auto-regressive moving average (NARMA) modeling of time series