

storengy



# EXPERTISE SERVICES

A company of **ENGIE**



# STORENGY: FROM THE DESIGN THROUGH THE OPERATION OF COMPLEX INDUSTRIAL SITES



**Storengy designs, builds and operates underground gas storage (UGS) facilities and offers its customers innovative products and top quality services based on the extensive know-how, acquired through almost 60 years' experience with different markets and regulatory environments.** Drawing on its world-renowned knowledge and its experience in storage capacity marketing & sales in France, Germany and in the UK, Storengy supplies cutting edge solutions to partners and customers worldwide (in China, India, Brazil, Turkey, Chile, Mexico) in a vast range of projects, favouring an industrial approach structured around partnerships.

Storengy owes its current position to its expertise in subsurface sciences, coupled with high-level skills in such varied fields as market analysis, drilling and exploration techniques, underground reservoir engineering, solution mining, surface facility operations, industrial safety management and sale of storage capacity. Its winning combination of multi-disciplinary teams, cutting-edge expertise and a strong innovation culture has made Storengy a key player in the development of geothermal energy (heat production and power generation) and the creation of pioneering energy storage solutions.

Storengy's strategic aims focus firmly on the energy transition, greater local rootedness and innovation, all with a view to pursuing and promoting its core industrial activity of gas storage, developing it both domestically and worldwide, and diversifying into new areas of business.



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## OUR SCIENTIFIC PARTNERS

Storengy draws on the expertise of several major scientific and academic partners (Mines Paris Tech Université, IFPEN, Stanford University, Ecole Polytechnique, Université Pierre et Marie Curie Paris VI, Institut National Polytechnique de Toulouse, Auckland University...), with a strong and lasting involvement in international professional upstream and solution mining associations such as the Solution Mining Research Institute (SMRI), the Society of Petroleum Engineers (SPE), the European Association of Geoscientists & Engineers (EAGE) and the Society of Petrophysicists and Well Log Analysts (SPWLA). Our long-term relations with these centres of excellence ensure that Storengy benefits from cutting-edge expertise and extensive know-how.



SOLUTION MINING  
RESEARCH INSTITUTE

# STORENGY AT A GLANCE

## WHY STORE GAS?

As natural gas consumption varies significantly depending on the time, day and season, underground gas storage ensures reliable and continuous supply throughout the year. Gas storage is essential in order to cover natural gas needs during winter consumption peaks. Storengy's working gas volume enables it to guarantee the security of supply of natural gas.

## WHY STORE GAS UNDERGROUND?

Underground gas storage in sealed subsurface geological formations allows for large volumes of gas to be stored whilst guaranteeing a high level of safety.

## STORAGE: OUR CORE BUSINESS

For the last 60 years, Storengy has been designing, developing and operating several natural gas storage facilities. Thanks to this large UGS experience, Storengy has acquired in-depth expertise in subsurface sciences and surface equipment and engineering technologies. This expertise is made available to industries and public-sector customers with a view to make use of all types of underground gas storages.

**12.2**

**billion M<sup>3</sup>**

of working gas storage capacity

**N°1**

**storage operator**

in Europe and

**N°3**

**operator** in the world

**21**

**storage sites** in Europe

**€1,1 b**

revenue in 2015

over

**1,000**

employees

## OUR EXPERTISE

### PARTNERS WHO BECAME CUSTOMERS

Our know-how is founded on our recognised experience of designing and operating complex industrial sites and our almost unique expertise in the field of subsurface sciences. Storengy is currently developing the whole range of subsurface and engineering consultancy services.

## OUR SITES

### AN INTERNATIONAL FOOTING

Storengy develops and operates underground natural gas storage facilities in France, Germany and the United Kingdom. As an internationally renowned partner, Storengy is also present in Canada and China. The company also provides its industrial know-how and expertise to a large number of partners across the world on a wide range of projects.

# OUR EXPERTS

## THE WELL SERVICES DEPARTMENT (GIP)

In the last 60 years, Storengy has put together its own teams of experts specialising in well architecture design, drilling, work-over and snubbing, well maintenance operations, wireline work, logging, well integrity management and long-term operational monitoring of well performance.

During operations, Storengy manages and monitors well performance by carrying out suited and optimized well maintenance programs.



*"Storengy's drilling/equipment experts devise well projects and the related technical specifications in compliance with professional standards. Compliance with administrative regulations is the cornerstone of all our projects. Safety is an essential aspect of operations."*

**Moïse RAIMONDEAU** (Head of the Well Engineering Department)



## EXPERTISE CENTRE

Storengy boasts expertise in all of the subsurface sciences, including geophysics, geostatistics, geology, reservoir engineering, rock mechanics, and solution mining technology as well as all surface engineering, e.g. compression, gas treatment, and control & command. Since Storengy has developed several high-performance subsurface modelling tools in-house, its engineers are able to predict and efficiently monitor the behaviour and performance of salt caverns, depleted fields and aquifer gas storage facilities. They are seasoned professionals in the field of complex surface sites.

Storengy is world-renowned, particularly for its salt cavern expertise: site identification, cavern design & leaching, technical and contractual management of brine and thermodynamic expertise.

*"Storengy's Expertise Centre runs a multi-disciplinary R&D programme, drawing upon its own in-house know-how and that of the ENGIE group. We have concluded a large number of partnerships with centres of excellence, such as IFPEN, Ecole des Mines de Paris, Ecole Polytechnique and SMRI. The fields of research cover all areas of geosciences, surface/subsurface facilities and wells."* **Olivier MACHET** (Director of the Expertise Centre)



# RENOWNED AND RECOGNISED EXPERIENCE ON THE INTERNATIONAL STAGE

**Storengy is developing its business on the international stage and promoting its cutting-edge expertise among countries that want to set up storage infrastructure or initiate geothermal projects.**

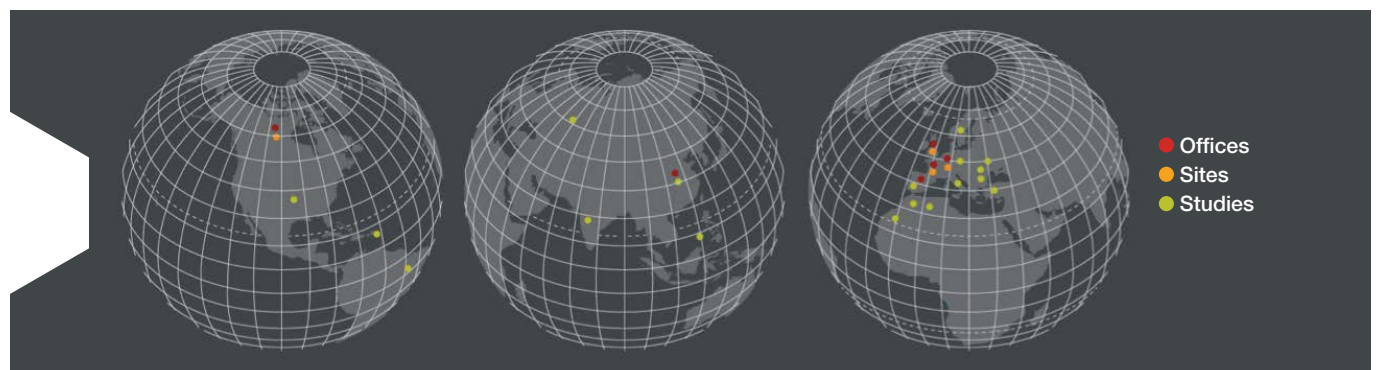
## OUR REFERENCES

### FOCUS ON ASIA

Bolstered by economic growth, gas demand is on the increase in Asia. Storengy has become a key partner for gas authorities and companies, particularly in China and India. Through its high value-added service provision, the company aims to develop long-term partnerships in the storage sector in these high-growth markets.

### OPERATIONS AND MAINTENANCE FOR THIRD PARTIES IN GERMANY

In 2014, Storengy Deutschland Betrieb was awarded the operation/maintenance contract for the storage facilities of Trianel, which is a consortium comprising primarily local utility companies. Trianel Epe is the fourth storage site managed from Storengy Deutschland's centralised dispatching centre.



# OUR CONSULTANCY SERVICES

**Storengy offers services spanning the entire life cycle of industrial projects, covering all of the following stages: exploration and development studies, implementation, operation, biodiversity management, site decommissioning & shutting-down or redevelopment.**

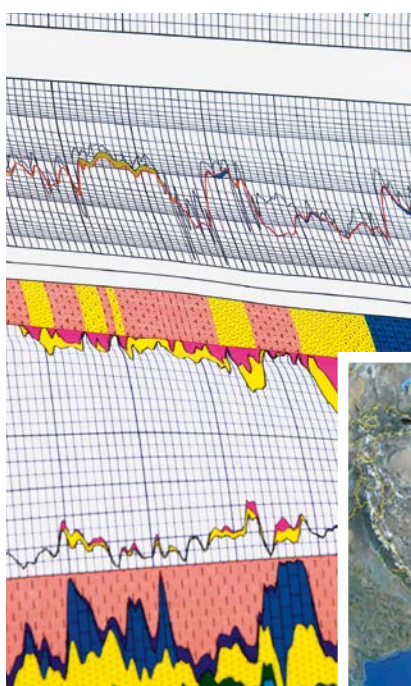
## STUDIES

### DESIGN STUDIES

Storengy's expertise in subsurface sciences and surface facilities is a major asset in terms of the design and implementation of projects.

Its experts are involved from the early phase of a project, particularly through its geoscience consultancy work force.

**Its teams are qualified and trained in the following techniques:** 2D and 3D seismic surveys acquisition, processing & interpretation, geological and hydrogeological structural studies, analysis of petrophysical and geological data from logging, drilling designing and executing, reservoir engineering, salt cavern modelling, leaching design & salt cavern construction, test-phase schedules, industrial safety and regulations, process studies, industrial IT and automation and environmental impact studies.



Evaluating assets in China for Petrochina Storengy - 2013

## ANALYSES

### ANALYSIS OF POTENTIAL OPPORTUNITIES

From the early stages in the strategic analysis of its public sector or industrial customers, **Storengy can conduct explorations and analyses of potential natural gas storage or geothermal sites, perform risk assessment, make investment estimates, draw up development plans and manage of permitting procedures.**

### ASSET STUDIES FOR THIRD PARTIES

Storengy uses its gas market knowledge to assess storage assets for potential investors and investment funds. One of its strengths is conducting peer reviews of the gas storage market for third parties.

## OPERATION

Storengy provides project teams and operators with the expertise they need to optimise the operation of their facilities and the overall running of their sites.

**Thanks to its experience and know-how, Storengy provides long-term operating services through its continuous improvement plans.**

Storengy's experts are well-versed in all of the following industrial techniques: gas treatment process engineering, compression expertise, automation, instrumentation, electricity, IT, pipes, pumping, civil engineering, maintenance, and centralised steering and control centres.



## IMPLEMENTATION

Storengy is highly skilled in developing industrial facilities for gas storage and geothermal power generation or district heating.

**Our services cover all of the processes involved in the implementation of a project:** assistance with drilling, test phases, monitoring of surface and subsurface facilities and facility commissioning.

## OUR ASSETS

- › Ability to improve your performance
- › Expertise that is maintained and continuously enhanced in the course of operating our own assets and those of third parties
- › Management of environmental aspects
- › Unique know-how in an area subject to stringent standards and regulations



# OUR CONSULTANCY SERVICES



*"We know that our industrial activities have an impact on their surrounding environment. We also know that biodiversity is under threat. It is thus our responsibility to take steps to sustain and, where possible, improve biodiversity. Also at stake is the acceptability of our activities among stakeholders, including local authorities, associations, administrations and the general public, who are taking an increasing interest in environmental care. Our goal now is to establish and further develop a long-term biodiversity strategy."* **Denis LECA** (Head of Solution Mining Department - Expertise Centre)

## MANAGEMENT OF ENVIRONMENTAL ASPECTS

In the scope of current environmental challenges and thanks to its technological expertise, Storengy can provide services to its customers that factor in economic and environmental considerations. Since 2010, Storengy has been taking proactive steps to enhance biodiversity, which encompasses species conservation and appropriate management of natural spaces. This strategy is gradually being rolled out across all of Storengy's storage sites.

Consequently, Storengy can provide expert advice on biodiversity conservation to help its customers reduce their environmental impact and facilitate the management of green spaces on sites.



Denis Leca (Storengy - BIODIN Project Manager) receiving the 'recognised National Biodiversity Strategy (NBS) commitment' certification from Minister Ségolène Royal in acknowledgement of Storengy's active commitment to biodiversity.



## INDUSTRIAL SAFETY

Industrial safety is a major challenge for Storengy, whose European sites are classified as high-threshold Seveso sites, which means that they have the highest risk level for industrial facilities. Over 60 years, the company has developed real expertise in assessing risk and drawing up safe systems of work to meet the highest standards of safety for facilities and people.

### SITE CLOSURE AND REDEVELOPMENT

Managing the end of a site's life requires a whole host of different competencies – all of which Storengy has at its disposal, thanks to the teams at its Expertise Centre.

Its experts are qualified to devise tailor-made sites shutdown plans, whilst also keeping a close eye on changes to caverns over the shutdown period.

Its subsurface modelling expertise and management of leaching-related phenomena enable it to provide sound risk management. Storengy can also conduct redevelopment studies based on pre-defined objectives.

*"«Storengy's success depends on our ability to constantly improve the quality of our services and our customers' performances. Emphasis must be placed on achieving pre-defined objectives, as well as on protecting human health, industrial safety and the environment. This policy is for the benefit of our staff, customers and subcontractors, stakeholders and the wider community in which we live and work.» Cécile PRÉVIEU (Chief Executive Officer of Storengy)*



# OUR AREAS OF EXPERTISE

## SALT CAVERNS

### OUR EXPERTISE

Storengy has a unique expertise in the field of salt caverns (design, development, injection of commissioning gas, wells, operation and shutdown), which it has developed to meet the stringent requirements of the natural gas storage sector.

Over 60 caverns have been designed, leached, injection of commissioning gas and are now operated by Storengy.

We have significant know-how available thanks to our in-house experience, which has been gained through operating our own storage facilities for several decades in France and across the world.

### OUR IN-HOUSE SOLUTION MINING TOOLS

- Simless: leaching simulator
- Cavplanner: Solution Mining System Monitoring (gas caverns or brine production purpose)
- Viplef3D: geo-mechanical simulator
- Déméther: thermodynamic simulator

We thus have expertise when it comes to monitoring these caverns and redeveloping them for energy storage.

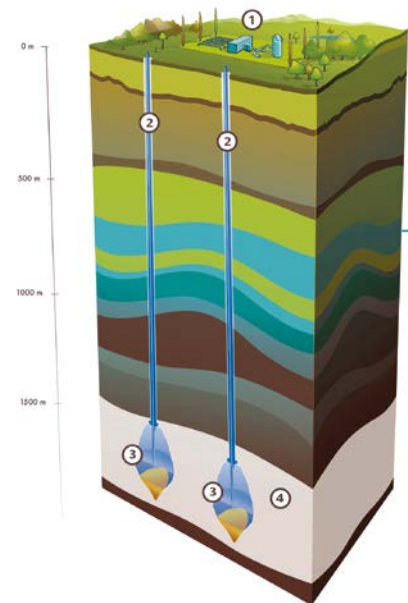
## DEPLETED FIELDS

Some depleted natural gas or oil fields can be converted into underground gas storage sites.

This entails re-injecting natural gas into a geological formation that contained hydrocarbons for several million years. Converting a depleted oil field into a gas storage site helps enhancing oil recovery. This technique, which has been developed in-house by Storengy, is known as STorage While Enhanced Oil Recovery (STWEOR).

### OUR SERVICES

- Drilling monitoring
- Well Integrity Assessment & Management
- Hydrocarbon recovery
- Conversion programme

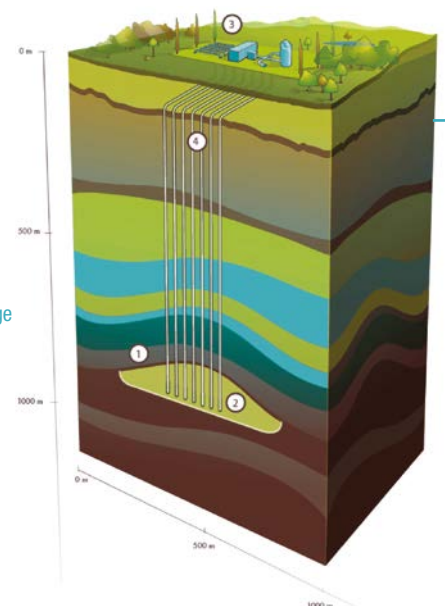
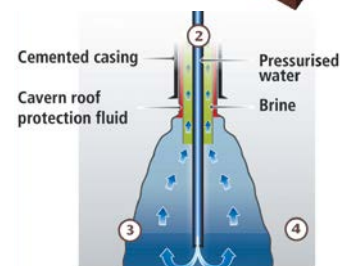


### Technique used Salt cavern gas storage

#### Characteristics:

- Lower effective volume
- High withdrawal rate

- 1) Central station
- 2) Operation wells
- 3) Salt cavern
- 4) Rock salt layer



### Technique used Depleted field for gas storage

#### Characteristics:

- High effective volume
- Withdrawal rate depends on the reservoir's porosity and permeability

- 1) Cover
- 2) Reservoir (depleted field)
- 3) Central station
- 4) Operation wells

## EXTENSIVE KNOW-HOW

- › Subsurface expertise: Exploration, Development, reservoir engineering
- › Design, Construction and Operations of surface facilities
- › Well Services
- › Integrated Quality, Health, Safety and Environment (QHSE) system

## AQUIFERS

Aquifer gas storage sites have an identical geological structure to that of depleted fields. In order to make use of them, pressurised natural gas is injected deep into the rock.

The gas gradually replaces the water without changing the underground architecture.

### OUR SERVICES

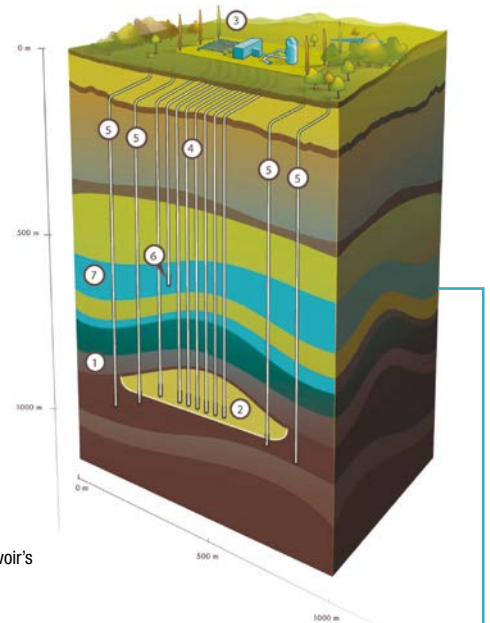
- Drilling consultancy
- Geophysical expertise (acquisition/Processing / Structural analysis)
- Geological, petrophysical expertise
- Subsurface impact studies (pollutant dispersion)
- Reservoir modelling & simulation
- 3D multi-wells and multi-phase (gas/water/oil) reservoir modelling & simulation

### Technique used Aquifer gas storage

#### Characteristics:

- High effective volume
- Withdrawal rate depends on the reservoir's porosity and permeability

- 1) Cover
- 2) Reservoir
- 3) Central station
- 4) Operation well
- 5) Control wells
- 6) Control well for the upper aquifer
- 7) Upper aquifer



## GEOTHERMAL ENERGY PROJECTS

Its winning combination of multi-disciplinary teams and cutting-edge expertise in hydrogeology, geophysics & geology, geochemistry, reservoir modelling and well drilling has awarded Storengy in-depth geothermal expertise which has made a key ENGIE group player in the development of geothermal energy.

Storengy is involved in all types of geothermal projects - heat production and electricity generation - and its expertise can be implemented:

- upstream to assess fields' capacity & performing exploration and development from design to fulfilment with respect to regulatory files;
- during construction in terms of engineering and to supervise drilling operations;
- during operations to monitor and optimise generation and assets maintenance (particularly well equipment).

# TAILOR-MADE SOLUTIONS

Storengy has a wide range of customised and adaptable services, enabling it to provide every customer with bespoke solutions. The company can draw on its significant experience of the industrial sector and can tailor its assistance to the activities of its customers.

## EXPERTISE TAILORED TO EACH CUSTOMER

As an asset owner and operator, Storengy is a genuine partner of its public-sector and industrial customers. Our goal is to implement solutions that enhance the performance of our customers.

### Our customers:

- Solvay
- Trianel
- Géopétrol
- Bridge Oil
- Tractebel
- PetroChina
- Arkéma
- Kem One
- Vencorex

### Our markets:

- Chemical industry
- Salt industry
- Storage facilities
- Oil sector
- Local and regional authorities
- Gas sector

## CHEMICAL AND SALT INDUSTRIES

- Assistance with drilling
- Stability studies
- Salt cavern modelling
- Handling of regulatory requirements
- Monitoring of the drilling phase
- Recovery of salt mines
- Optimisation and scheduling of leaching operations
- Site closure and redevelopment

### LEACHING MODELLING

For over 35 years, Storengy has been assisting Solvay at its Etrez site.

This partnership has enabled salt production and salt cavern leaching to be optimised. Storengy also manages the brine pipeline linked to Solvay's infrastructure (total of 600,000 tonnes of salt per year).

*"Our extensive experience of the salt industry enables us to understand our customers' challenges and offer them tailor-made services. The know-how that the Expertise Centre has developed in the field of salt caverns means that we hold in-depth understanding of the technical issues involved in salt extraction."*

**Grégoire HÉVIN** (Salt Caverns Expert - Expertise Centre)

### SALT STREAM SERVICE: MAKING USE OF EXPERTISE IN SALT CAVERNS

Storengy provides its unique expertise in this area to enable its customers to optimise all the stages in their brine/salt production processes under the highest safety conditions.





**OVER 600** WELLS DRILLED

DRILLING DEPTHS OF UP TO  
**2,500 m**

## OIL AND GAS INDUSTRIES

- Seismic acquisition & processing design & supervision
- Geological & Reservoir Engineering studies & modelling
- Qualification of aquifer structures fit for purpose to UGS development
- Modelling of liquid dispersion in aquifers
- Well design
- Drilling supervision
- Assistance with energy storage

## LOCAL AND REGIONAL AUTHORITIES, STATES AND SEMI-PUBLIC BODIES

- Assistance with geothermal projects
- Land stability studies
- Biodiversity conservation
- Drilling studies and services in the field of water



### **BIODIN SERVICE: INNOVATION TO ENHANCE BIODIVERSITY**

The Biodin concept consists of setting up an approach for the 'appropriate' environmental management of a site, aimed at boosting biodiversity, reducing the environmental impact, stabilising or even reducing operating costs and maintaining green spaces.



# COMPREHENSIVE AND TAILOR-MADE SERVICES

Thanks to the expertise of its workforce and the advanced in-house developed subsurface modelling tools. Storengy provides integrated services.

SERVICES SPANNING THE ENTIRE LIFE CYCLE

INDUSTRIAL PROJECT MONITORING AND TAILORED SUPPORT

COMMITMENT TO RESULTS AND SUPPLY OF EXPERTISE FOR EVERY CUSTOMER

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A company of 