



A White Paper

# FESAPI

## *Simplifying the Deployment of Energistics Data Transfer Standards*

“FESAPI is a packaged solution that makes it easier to implement Energistics’ upstream data transfer standards while lowering costs and de-risking the process.”

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## Introduction

Most people and organizations agree: Use of standards streamlines digital operations, solves technical problems, and adds significant business value. But implementing standards can be challenging and complex.

To ease and speed up implementation, an Application Programming Interface (API) has been developed and is now available for use. Named FESAPI, it is an open source, high-level software development tool kit. Programmers can use software classes produced by FESAPI in the products they develop. FESAPI reads the industry-defined standard Energistics data transfer formats—specified as XML schemas—and converts them into classes in multiple programming languages. When programmers use FESAPI classes, they do not have to write this code themselves. Using FESAPI classes also ensures consistency in the interpretation and implementation of the standards.

The development of FESAPI is a partnership with the Energistics Consortium, which ensures that FESAPI honors the Energistics' standards. It allows participating members to set priorities, test the FESAPI-produced classes, and conduct work under the rules of the Energistics Consortium's antitrust framework and infrastructure.

The initial focus for FESAPI has been for RESQML v2.0.1 and the key components of the Energistics Common Technical Architecture (CTA) used by RESQML, such as the Energistics Packaging Conventions (EPC) and HDF5, the technology suite published by the HDF Group and used by Energistics for storing and managing large, complex data arrays.

Development of new features of FESAPI is ongoing and is scheduled to expand to all of Energistics' data formats—WITSML (well/drilling), PRODML (production operations, analysis and reporting), and RESQML (earth modeling, subsurface, simulation)—as well as, including the Energistics Transfer Protocol (ETP).

## The Story of FESAPI

Initial development, before it was officially named FESAPI, began at French IT consultancy Geosiris (<http://geosiris.com/>) with an international operator to help the company's internal software development teams implement RESQML. It was led by co-founder and principal consultant Philippe Verney, Ph.D.

In 2014 Mr. Verney launched F2i-Consulting (<https://f2i-consulting.com/>), a software development consultancy that worked initially with the initial international operator. Mr. Verney continued to develop and evolve the API, which was eventually re-branded as FESAPI.

Over time the operator recognized that data transfer standards would have the most value when everyone in the E&P ecosystem—operator/partners, service, and software companies—would be using them. So FESAPI was made available as a multi-programming-language, open source tool for the entire E&P community. The project manager at the operator said: "Our Company has been committed to and realizing value from RESQML and its predecessor standard RESCUE in our internal workflows. But we have partners with whom we must also exchange data, and we have many commercial software packages that are part of our standard workflows. The more companies that adopt and implement RESQML, the more value we can realize."

## FESAPI Delivers Benefits to Numerous Organizations

As a high-level software development tool kit FESAPI reads the Energistics data transfer standards and converts them into classes in multiple programming languages that read and write the industry-defined Energistics data formats. Programmers use software classes produced by FESAPI in the products they develop, which saves them time because they don't have to write the code themselves.

Several Energistics member organizations are leveraging FESAPI to shorten the time needed to implement the standards while ensuring that these developments are consistent and comply with the published standards. Major multinational operators, independents, global oilfield service groups, national organizations, technology companies, and others are among the active users of FESAPI.

Carl Godkin, the Development Manager of Dynamic Graphics Inc (<https://www.dgi.com/>) explains, "Using FESAPI has saved us an enormous amount of development and debugging effort. Our company relies on FESAPI for our CoViz 4D RESQML implementation because of its high quality and straightforward API. RESQML depends on XML documents, HDF5 bulk storage, and the Energistics Packaging Conventions, but by using FESAPI we do not need to build anything around these technologies. We simply work with FESAPI's well-documented and carefully maintained API, bypassing the intricacies of the technologies in its stack. We are looking forward to the same benefits when FESAPI adds robust support for the Energistics Transport Protocol."

A research associate from one of the major oil company members finds working as part of the FESAPI initiative to be very productive. As a key part of the process, initiative members can identify and prioritize the standards' capabilities that will be incorporated into upcoming FESAPI releases. The FESAPI development team is responsive and new functionality is typically available within 3 to 4 months.

## A New Initiative to Drive Development

The current version of FESAPI is available as an open source library and project. To ensure that FESAPI continues to meet the most pressing industry needs, an initiative was recently launched to help prioritize and fund future development. Major operators ExxonMobil and Total, together with software technology company Dynamic Graphics Inc, are the initial supporters of this undertaking. Like the FESAPI developments achieved to date, the new initiative is being managed within the Energistics Consortium's rules. Members who are contributing to this initiative, currently all from the RESQML Special Interest Group (SIG), vote to prioritize FESAPI development tasks. This work is organized in parallel with the regularly scheduled in-person Energistics SIG meetings that take place three times per year; new initiative members also meet in online conference calls as needed to discuss requirements, project status, and testing.

To provide more resources and accelerate the new initiative, the door is open for other companies to join. Operators, oilfield service companies, software technology companies and integrators are welcome to step in and contribute, please use the contact information at the end of this paper to get in touch.

Like most other open source projects, FESAPI has a continuous integration process, with the periodic posting of the latest updates to a repository for people to download at their convenience. Users are encouraged to contribute new functionality, and a message forum is available to report and resolve issues.

### ***What Makes FESAPI Different?***

FESAPI has some founding principles that guide its development and deployment:

- **Community-driven.** The community of E&P professionals, through Energistics, drives the direction of FESAPI development. F2i developers execute and deliver the work, but it is the community that prioritizes what will be worked on.
- **Multi-language.** From the start, FESAPI has been designed to support multiple programming languages, so that as many software development groups as possible can use it. FESAPI has been architected such that the design and the fixes to the logic are propagated through all the software language classes produced.
- **Multi-ML.** The FESAPI design is inclusive of all Energistics domain standards (RESQML, WITSML and PRODML) and the Energistics Common Technical Architecture, including the Energistics Transfer Protocol.

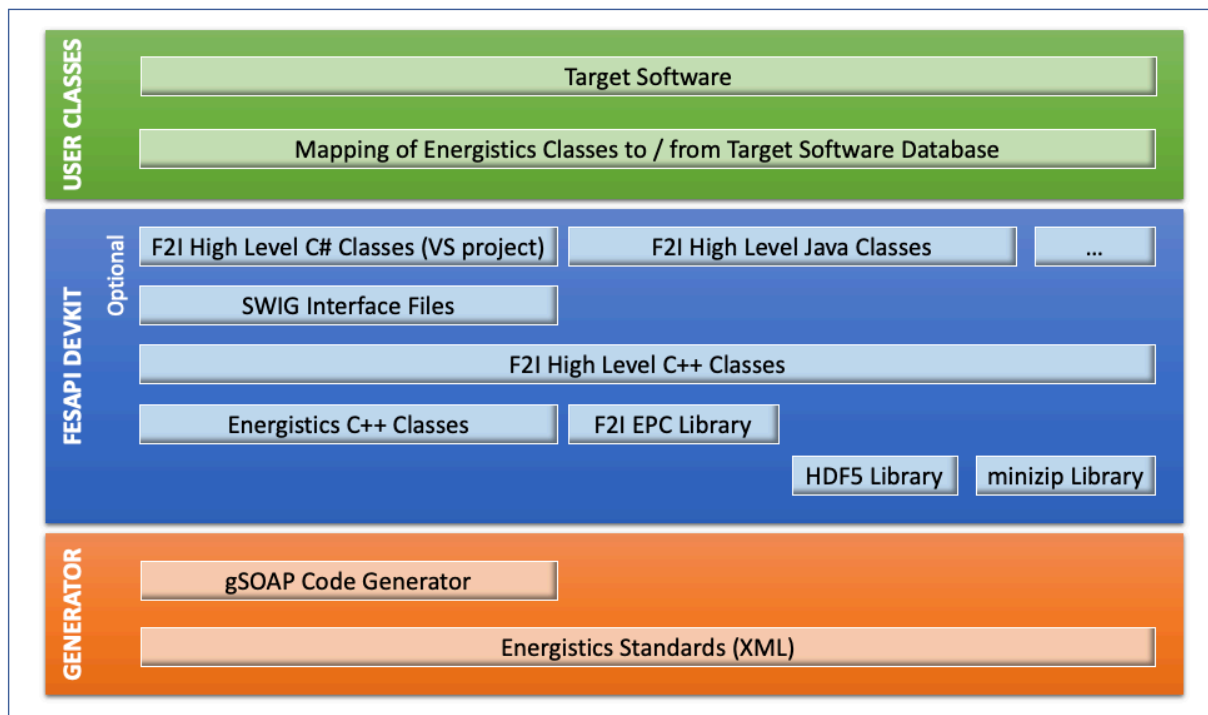
## Technology Overview

### FESAPI Classes

Currently, FESAPI delivers classes for these Energistics standards:

- Extensive support for RESQML v2.0.1 including Energistics Packaging Conventions (EPC) and HDF5.
- Support for WITSML v2.0 includes wells, wellbores, trajectories, wellbore perforations, wellbore geometries, logs, channel sets, and channels.
- Support for PRODML v2.1 includes fluid system and fluid characterization (PVT).
- Active development for ETP v1.2 (though not yet for real-time well data access) includes these ETP sub-protocols: Core, Discovery, Store, StoreNotification, and DataArray.

FESAPI is released under an Apache 2.0 license and located on a GitHub repository. *Figure 1* breaks down the main FESAPI components and the related technologies, which are explained below the figure.



*Figure 1* This figure breaks down the main technologies and components used in FESAPI.

At its lowest implementation layer within the orange area, FESAPI is developed in C++03, soon to be replaced by C++11. FESAPI first converts all Energistics XML schemas into C++ classes using a commercial Apache 2.0 license usage-compliant version of Genivia gSOAP, which is included in FESAPI with no external dependency.

The blue area comprises the C++ wrappers that have been developed on top of the C++ classes to hide all the gSOAP, EPC, and HDF5 complexity. The SWIG interface files make it possible to automatically port

the same implementation into all other languages that SWIG supports. Currently, C# and Java implementations are available, and a Python implementation is close to completion.

From the green area representing the user side, developers need to map their internal data model to the Energetics data model, which is a one-time task. They then use the FESAPI-produced classes in their software applications to read and write the industry-defined Energetics format.

### Use of CMake

Using CMake, FESAPI can be built for:

- Windows, starting from Visual Studio 2015
- Linux (GCC 4.8 and Clang 5 have been tested)
- macOS (Clang)

### External Dependencies

FESAPI has some external dependencies, meaning that a developer must download these open source resources from their prospective providers. These are:

- HDF5 1.8.19+ or HDF5 1.10.2+
- minizip 1.1
- libuuid (only on Linux OS)

### ETP v1.2 Implementation

To implement ETP v1.2, these other external resources are needed:

- Beast library from Boost 1.66 (to 1.69) project
- Avro 1.9

### Continuous Integration

Continuous integration is done using these GitHub third-party tools:

- Codacy is used to verify the code quality.
- Travis is used to check builds and perform unit tests on Linux (and soon macOS).
- Azure DevOps is used to check builds and perform unit tests on Windows.
- Catch library is used as the unit testing framework.

Currently, a minimum of 3 releases per year are planned around the RESQML SIG meetings.

## For More Information about FESAPI

- To enquire about becoming a member of the FESAPI development initiative, contact [jana.schey@energistics.org](mailto:jana.schey@energistics.org).
- To download and use FESAPI, go to <https://www.f2i-consulting.com/>, which provides access to the GitHub repository and the forum.

## References

Avro	<a href="https://avro.apache.org">https://avro.apache.org</a>
Azure DevOps	<a href="https://azure.microsoft.com/en-us/solutions/devops/">https://azure.microsoft.com/en-us/solutions/devops/</a>
Boost.Beast	<a href="https://www.boost.org/doc/libs/1_66_0/libs/beast/doc/html/index.html">https://www.boost.org/doc/libs/1_66_0/libs/beast/doc/html/index.html</a>
Catch Library	<a href="https://github.com/catchorg">https://github.com/catchorg</a>
Clang	<a href="https://clang.llvm.org">https://clang.llvm.org</a>
CMake	<a href="https://cmake.org">https://cmake.org</a>
Codacy	<a href="https://www.codacy.com/">https://www.codacy.com/</a>
Genivia gSOAP	<a href="https://www.genivia.com/products.html">https://www.genivia.com/products.html</a>
HDF5	<a href="https://www.hdfgroup.org/solutions/hdf5/">https://www.hdfgroup.org/solutions/hdf5/</a>
libuuid	<a href="https://linux.die.net/man/3/libuuid">https://linux.die.net/man/3/libuuid</a>
minizip	<a href="https://www.winimage.com/zLibDll/minizip.html">https://www.winimage.com/zLibDll/minizip.html</a>
Travis	<a href="https://travis-ci.org">https://travis-ci.org</a>

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*F2I-Consulting*

*56, rue de Tivoli, 33000 Bordeaux, France*

*Energistics Consortium Inc.*

*3900 Essex Ln suite 1110, Houston, TX 77027, USA*