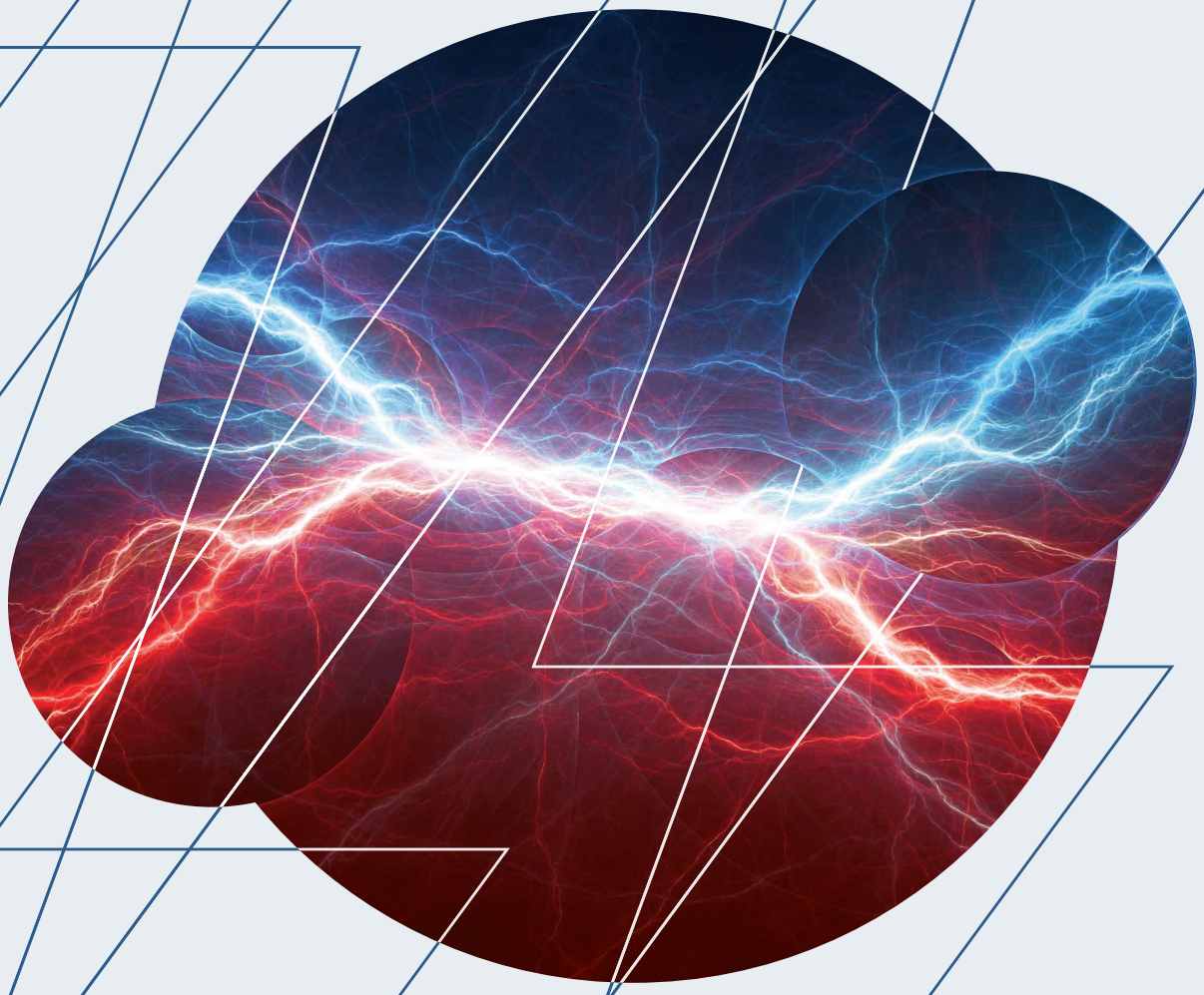
EnergyRisk

Energy 25

2019



Chartis

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About Chartis

Chartis Research is the leading provider of research and analysis on the global market for risk technology. It is part of Infopro Digital, which owns market-leading brands such as Risk and WatersTechnology. Chartis' goal is to support enterprises as they drive business performance through improved risk management, corporate governance and compliance, and to help clients make informed technology and business decisions by providing in-depth analysis and actionable advice on virtually all aspects of risk technology. Areas of expertise include:

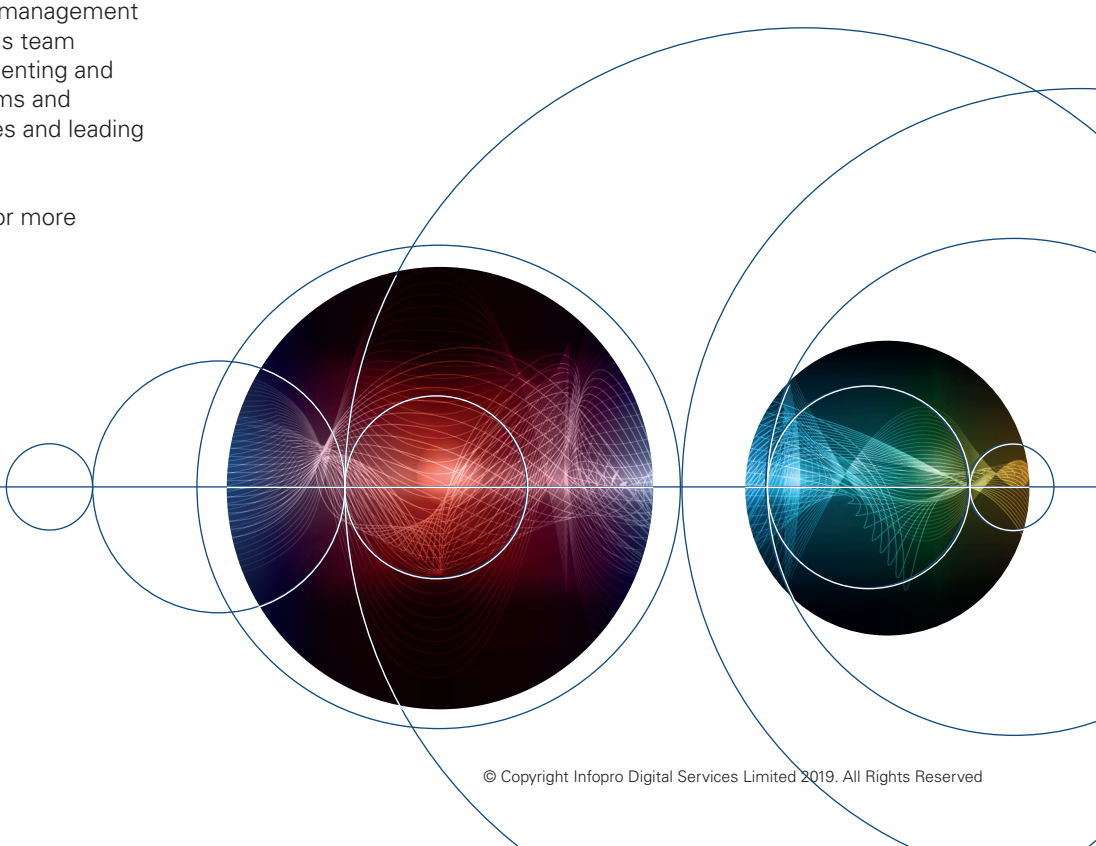
- Credit risk.
- Operational risk and governance, risk and compliance (GRC).
- Market risk.
- Asset and liability management (ALM) and liquidity risk.
- Energy and commodity trading risk.
- Financial crime including trader surveillance, anti-fraud and anti-money laundering.
- Cyber risk management.
- Insurance risk.
- Regulatory requirements including Basel 2 and 3, Dodd-Frank, MiFID II and Solvency II.

Chartis is solely focused on risk and compliance technology, which gives it a significant advantage over generic market analysts.

The firm has brought together a leading team of analysts and advisors from the risk management and financial services industries. This team has hands-on experience of implementing and developing risk management systems and programs for Fortune 500 companies and leading consulting houses.

Visit **www.chartis-research.com** for more information.

Join our global online community at **www.risktech-forum.com**.



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1. Foreword

I'm delighted to welcome you to the very first Energy25, a new study from Chartis Research that provides a comprehensive view of the world's major technology players in modern energy markets. The energy space has always been an important area of research for Chartis, one that we have covered in detail for several years. Now, together with our sister brand Energy Risk, we have honed that research into a focused look at the current energy tech landscape and the players operating within it.

But why now? Quite simply because energy and energy trading markets have transformed in recent years. Against a background of concerned and concerted moves to adapt energy markets to the modern world, what role can technology play? A crucial one, as it turns out: we are now seeing important developments in this space that in many ways presage what is happening in other risk technology markets.

Much of the transformation has been driven by *data*. A surge in data across the energy sector – and elsewhere – has ushered in an evolution in the analytics used to assess market variables and factors as complex and diverse as pricing curves, supply chain risk and demand forecasting. Alongside the ever-present influences and implications of regulatory and environmental dynamics, and the impact of these and other factors on energy trading markets, there is plenty to consider.

To track these shifting markets and dynamics, Chartis plans a series of research reports examining various aspects of the space, providing our customary in-depth analysis of the market and vendor landscape.

So what can you expect from Energy25? Those of you familiar with Chartis' RiskTech100® rankings and awards will recognize the structure of this report. After providing an overview of our research and the industry categories it covers, we summarize some of the key market trends in the energy space – including growth in liquefied natural gas (LNG) and renewables, the increasing sophistication of database technologies, and the shifting economics of the refinery business.

Then, a short research paper by Chartis Research Specialist John MacDonagh examines just how important data and analytics have become in energy markets, and considers how institutions might apply these increasingly sophisticated tools and techniques more effectively. Finally, we present the rankings and category winners for the inaugural Energy25, followed by an outline of the methodology we used to determine our results.

With Energy25 we believe we are helping to capture, define and analyze an important period in the development of energy markets, and providing an invaluable yardstick for all participants.

It only remains for me to congratulate the winners of Chartis and Energy Risk's first Energy25 awards, and hope that you enjoy this report.

Rob Stubbs, Head of Research

2. Overview

The companies featured in Energy25 are software vendors from a variety of backgrounds, and the users they target across the energy space – from asset managers to utility companies – are similarly varied. While these software and technology firms can differ considerably, however, they share common qualities that rank them highly in the energy space.

We calculate the Energy25 based on the following category classifications:

- Functionality
- Core technology
- Market presence/impact
- Innovation
- Strategy

For Energy25 we only consider software vendors that provide their own software. Many of these firms also provide consultation and professional services to assist with their software implementations, but those that do purely consultative work – without their own software component – have been excluded from this ranking.

3. Key highlights

In this section we consider several market trends that we feel are particularly important in the energy space, and which are contributing to the fluid and dynamic nature of this technology landscape.

LNG: a market matures

Liquefied natural gas (LNG) markets continue to mature, but pricing issues and geopolitical uncertainty could affect trading for some time.

Because liquefaction uncouples the delivery of natural gas from pipelines, LNG can be sold into markets that could not previously access large volumes of natural gas. But the speed at which LNG has spread and grown into new markets has created a number of issues around how it is priced. Lacking a well-established local spot market to price against, traders have had to rely on alternatives. At first, oil-indexation (in which gas is priced against widely used crude oil benchmarks) seemed a viable possibility, but pricing seems to be shifting away from this option, because it links two commodities that have different supply and demand fundamentals.

Many traders have switched to pricing based on natural gas settlement prices on trading hubs, the most heavily used of which is the US-based Henry Hub, although its US focus makes it less suitable for other markets. In particular, the US LNG sector has seen strong growth as shale gas production has increased, and the 'first wave' of development is complete, involving the commissioning and construction of LNG 'trains' (facilities to liquefy and purify natural gas)

Efforts to create alternative pricing hubs have had mixed success, although some are now available in Europe and Asia. Notably, Asia is the largest sector for the import and use of LNG, while China is now the largest importer, after displacing Japan in 2018.

The LNG sector may be growing rapidly, but it is not immune to geopolitical risk, particularly in the context of trade between the US and China. With China as the fastest-growing importer, and the US with a glut of natural gas due to its shale exploration, it would seem that the two might be well-placed to set up long-term contracts. Indeed, LNG traders would likely welcome this. But the current trade war between the two governments (which currently manifests as a 25% punitive duty on US LNG imported into China) has severely reduced existing trade and further hampered future long-term contracts – some of which are critical for the US to continue its second wave of infrastructure development.

IMO 2020 guidelines: the cost of clean air?

As laws restricting the maximum sulfur content permitted in bunker fuel hove into view, oil markets could experience an extended period of heightened volatility.

From January 2020, new regulations stipulate that bunker fuel must contain no more than 0.5% sulfur – a sharp drop from the current figure of 3.5%. These rules – enforced by national regulators – will immediately prohibit use of the fuel that most ships currently rely on (high-sulfur fuel oil, or HSFO). As a result, firms will have to find an alternative that will inevitably end up more expensive, given the low cost of HSFO.

Alternative fuels are available (such as low-sulfur fuel oil, marine gas oil and LNG), but for refineries and shipping firms they are in many ways less convenient than HSFO. The most immediate problem for potential users is that all these alternatives have a cost premium relative to HSFO. Some also compete with products like diesel and kerosene, and their uptake could cause price swings in these existing products. Until the market settles – which could take several years – volatility is likely to be high in this space, driven by uncertainty among firms about how to comply. For many market participants, hedging strategies will be more important than ever.

Refineries: pressure to modernize

Pressure is on the refinery sector to improve performance and weather regulatory change.

Regulatory changes to marine fuel ushered in by the IMO will have strong implications for

the refinery sector - demand for HSFO will fall sharply, encouraging a change in firms' balance of products. More simple refineries - many of which use HSFO as a sink for sulfur-rich residual products - are ill-equipped to meet this demand. More modern refineries are in a much better position, as they have additional flexibility in their final product balance. Simple refineries now face pressure to upgrade their technology to bring them more into line with their more advanced counterparts.

This follows a more general trend whereby refiners have been modernizing their processes and capabilities. Such a move has long been a way to improve performance, but it is increasingly seen as a critical step to remaining relevant in the market. While some of this modernization involves upgrading refinery hardware, data is also a significant component, as are underlying technologies for data capture, storage and analytics.

Renewable energy: managing volatility

Despite its unpredictability, renewable power contrinues to grow, and a suite of options now exists to manage its risk.

Key economic and societal forces continue to drive growth in renewable power: strong demand, falling costs, better tools and storage, government initiatives - although these vary by geography - and a relative lack of fuel price risk.

One of the core issues with renewables is that power output can vary depending on the weather. It's possible that energy storage technologies (such as chemical batteries, fuel cells and momentum storage) will be able to smooth out this variation even at high adoption levels; until then, however, alternatives will be required. In physical grids, producers can compensate for any variation by adjusting the output from controllable sources.

For traders, volatile production can lead to excessive variation in revenue. Traders have several options to help them manage this - notably proxy revenue swaps, insurance products, and weather derivatives. By effectively exchanging a facility's variable output for a fixed revenue, proxy revenue swaps help to level out revenue. Several insurance products can also manage the variable load from renewables, including parametric insurance, which pays out if certain conditions are met (these could be something relatively low-key, like too much rain). Weather derivatives can vary greatly in their complexity, but at their most basic they offer a hedge against unfavorable (but not necessarily catastrophic) conditions.

Supply chain management: optimizing logisitcs, minimizing disruption

In a bid to reduce the effects of supply chain disruption, more energy trading firms are turning to supply chain management capabilities.

As physicals trading has increased, so has demand for data to support those aspects of it that the traditional derivatives-focused data landscape does not adequately cover.

Broadly speaking, supply chain management can be divided into two activities: managing and optimizing supply chain logistics, and minimizing the effects of disruption to the supply chain. A key aspect of the latter is third-party data. Trading physical commodities inevitably leads to complex webs of interaction between a firm's third parties. To manage these relationships, firms need data that details the nature of their interactions with their third parties, as well as interactions between the third parties themselves.

On the logistics side, transport, scheduling and storage optimization are important for physicals trading in particular, although they will also influence derivatives to some extent. Once again, data is critical in managing and monitoring supply chain logistics, and new supplies of data – some from unconventional sources like internet of things (IoT)-enabled warehousing devices – are increasingly being used for inventory management and tracking.

What's more, the glut of newly available data for logistics is setting the stage for analytical techniques that can optimize supply chain activities and ultimately improve decision-making.

4. Next-generation analytics: powering success

In recent years, advanced analytics, and the technology underlying them, have evolved. Few of these new capabilities and techniques are specific to the energy sector, which historically has tended to lag behind other industries when it comes to all things analytics. But many are well-suited to – and are having a significant impact on – certain energy-specific problems, and increasingly firms in the energy sector are using them to optimize and improve their performance. But not all are getting it right. To do that, firms must be aware of - and exploit - the interplay between the analytics themselves and the technology on which they operate.

Digitalization, data, and beyond

Cultivated by a general trend toward digitalization across industries, an abundance of new data has surfaced that firms can mine and exploit. The pressure is now on to adopt new techniques and technologies (both hardware and software) to glean maximum benefit from this data.

The tools, technology and processes currently emerging – notably artificial intelligence (AI) techniques, high-performance computing (HPC) and new database technologies – act as 'enablers', providing the computational power, underlying data, and data integration and formatting necessary for advanced analytics. Mostly these developments have occurred in non-financial sectors such as data science, statistics and computer science, but more recently they have been adopted and developed in the financial services sector.

The recent accelerated growth in these 'analytics enablers' has been driven by three factors:

- **Advances in physical hardware**. Thanks to manufacturing enhancements, several hardware processors (including field-programmable gate arrays (FPGAs), graphics processing units (GPUs) and application-specific integrated circuits (ASICs) can operate faster and more efficiently.
- **New database capabilities**. The number and variety of available databases, along with their capabilities, formats and strengths, has increased exponentially (there are now more than 100 distinct database choices available).
- **The increasing application of modern programming languages**. When used with certain databases or analytical techniques (such as array databases and analytics that require parallel processing), newer programming languages can make operations more efficient. These languages often sit at the center of well-developed ecosystems that support the increasingly complex interplay between modern analytics and their supporting hardware.

A revolution in energy: the analytics toolkit

Analytics tools and their enablers are starting to prove especially pertinent – and even revolutionary – in energy markets. The benefits these new capabilities offer can be applied not only to new data, but also to the more traditional datasets prevalent in energy markets. And some of the physical characteristics and peculiarities of the energy sector (such as dependencies on power grids and pipelines) have even prompted firms to apply technology in new ways – in load forecasting and microgrids, for example.

Chartis believes that many firms in the energy space are well-positioned to capitalize on these newly available technologies and glean considerable benefit from the available data. In our view, advanced analytical techniques – including evolutionary algorithms, machine learning (ML) and graph analytics[1] comprise elements of a 'toolkit' that energy firms can customize and apply in different configurations according to their intentions, budgets and specific use cases.

Crucially, use of advanced analytics is increasing partly because the sophisticated hardware and expertise they rely on are now more widely available. Hardware advances in particular have made computation-heavy analytics more suited to everyday use, and many analytical techniques are now much easier to implement.

[1] *For more information on specific AI techniques, see the Chartis reports 'Artificial Intelligence in Financial Services, 2019 – Demand-Side Analysis: Exploring the real value in new statistical techniques' and 'Artificial Intelligence in Financial Services, 2019: Market and Vendor Landscape'.*

What's more, the sophisticated technologies that currently underpin the 'analytics toolkit' enable firms to maximize the potential of each element, even helping them develop new techniques and implement analytical tools that may have been considered wildly impractical before.

So what are these vital enabling technologies, why and where are they being used in the energy sector, and how can firms get the most benefit from them?

What lies beneath: the technologies powering data analytics

Infrastructure and databases

Steady advances in the semiconductor industry have increased the performance (and cost-performance ratio) of computationally aligned infrastructure components[2] such as GPUs, FPGAs and ASICs. These are especially effective when applied to compute-intensive tasks, and their parallel structure enables the processing of the very large datasets increasingly used by energy firms.

To take advantage of these features, firms must choose the right database. Ideally, GPUs and other computationally aligned infrastructure should be paired with databases that store data in a suitable format, to create a 'hardware-accelerated' database. In the energy sector, the uptake of GPU-linked databases in particular has cemented GPUs as a cornerstone of the future landscape.

Hardware-accelerated databases aside, in recent years the database environment has become significantly broader. In the past, firms chose a database and then had to modify it to meet their needs. Now they have many database options to choose from, and are often able to select one that's designed specifically for a particular use case. Not only does this make implementing new databases easier, ultimately it results in databases that are more closely aligned with their intended function.

Using the right language

Modern programming languages have also played a significant role in improving the availability and efficiency of data analytics. Julia, for example, operates considerably faster than many of its competitors, and aligns well with certain database types (notably array databases). While other languages can be used in some contexts, they may require relatively cumbersome workarounds.

Another important consideration is the software and supplier ecosystem that surrounds a language. In that context, Python – with its extensive and well-developed ecosystem of libraries, frameworks and tools across a broad range of processes – is a strong option. Julia is less widely used, so has a more limited ecosystem, although it does have excellent library support for GPU-related tasks – a feature that energy firms are increasingly seeking out.

Working together: HPC and Big Data

Advances in technology have not only enabled analytical techniques to flourish, in many cases they also underpin the use of these techniques in the energy space. One striking example of this resides in the area of Big Data (see Figure 1). Big Data is often considered a collection of large datasets; however, it also includes a computational component - 'big compute' *on* Big Data - that can be overlooked.

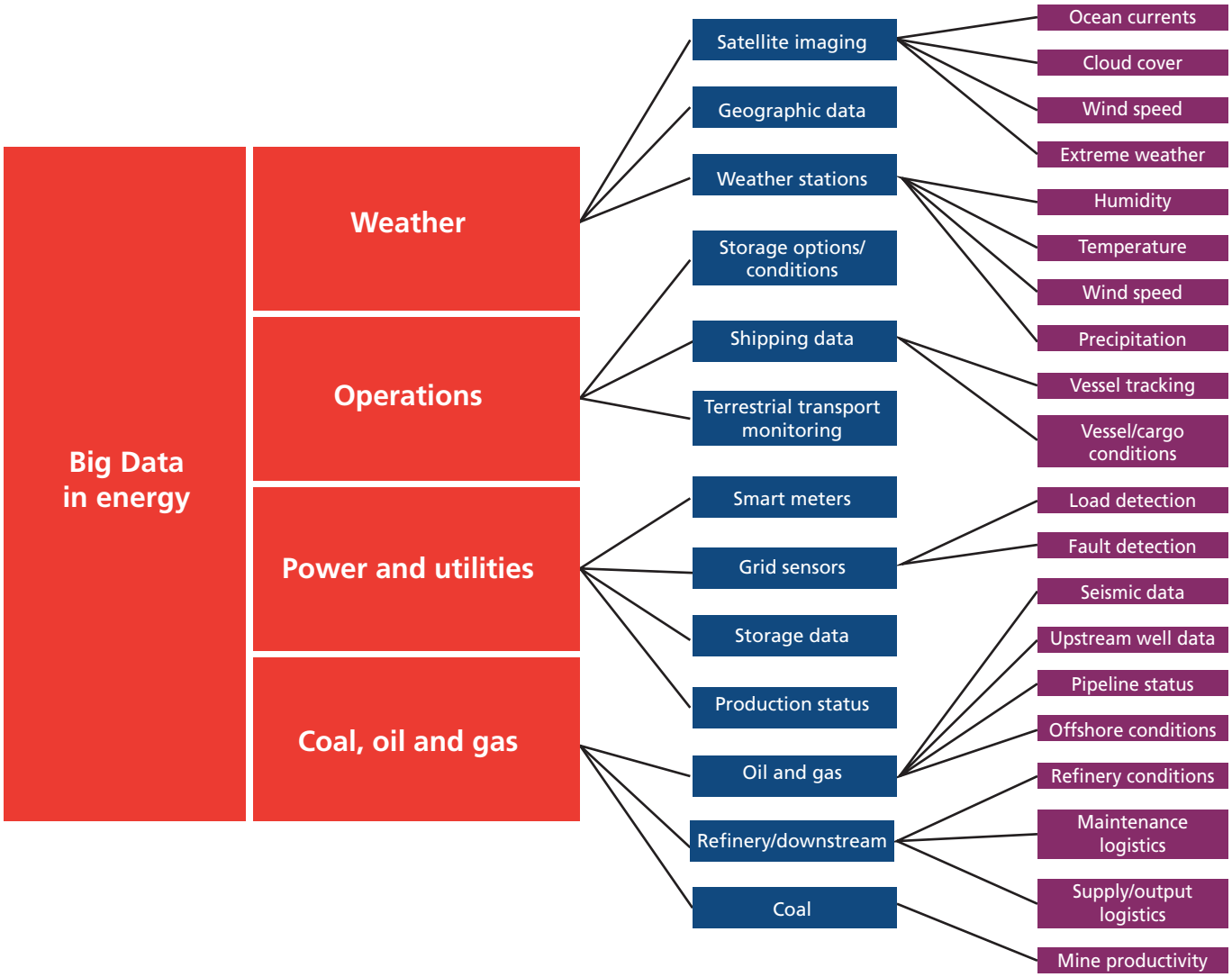
It is possible to store data in data lakes and use separate technology environments for the related calculations. But this approach is ineffective, because HPC stacks and Big Data stacks are designed for different processes and workloads. One possible option to consolidate Big Data landscapes using ill-suited analytics is a hybrid infrastructure that includes HPC stacks and Big Data stacks. While this is likely to be more difficult to implement, ultimately it will provide more effective support for analytics than an approach in which two systems are implemented separately and then integration functionality is added.

HPC is also changing the way in which one analytical technique – ML – is being implemented; together with GPUs (and other hardware acceleration components), it is driving advances in ML capabilities. The huge increase in processing power that comes with HPC's parallel processing capabilities allows users to train learning algorithms (particularly those built on neural networks) much faster than would otherwise be possible.

And as the complexity of the algorithm (or neural network) increases, and as the training data becomes more complex, hardware acceleration

[2] *Hardware that aligns well with specific, often highly demanding computational tasks.*

Figure 1: Big Data, big presence, covering many aspects of the energy landscape



Source: Chartis Research

becomes ever more important in achieving meaningful, timely results. Indeed, for firms with anything beyond a small neural network (those used for some forms of load forecasting, for example), hardware-accelerated computing seems a logical choice.

The tools for the job: identifying successful energy use cases

Reflecting the industry itself, the analytical techniques available to energy firms are extremely varied. Adoption also varies – whereas some techniques are only now being taken up, others have been in use for some years, and may even be ceding their place in the organization to alternatives.

AI in load forecasting

One of the areas in which advanced analytical techniques have been most effective is load forecasting. Load forecasting is a vital component of power markets, enabling users to forecast energy consumption at various timescales. These forecast timescales can differ significantly, ranging from minutes to several years. Timescales are

Figure 2: Load forecasting: many factors to consider, depending on timeline

	Forecast factors	Use case
Short term (<1 week)	• Weather • Calendar variables and events • Customer variables	• Network planning • Supply/demand matching • Spot power procurement • Load shedding strategy
Medium-term (1 week – 1 month)	• Weather • Growth rate/new customers	• Network planning • Supply/demand matching • Power procurement • Utility ratemaking
Long-term (> 1 month)	• Weather • Population growth • Economic development • Industrial activity • Technology development	• Capacity and investment planning • Fuel mix decisions (for future power generation)

Source: Chartis Research

often calculated based on several influencing factors - the more factors involved, the more complex load forecasting can become (see Figure 2).

Using load forecasting, power providers can optimize the supply and storage of their fuel, calculate how much excess power they will have to sell, and manage their fuel mixes. Effective load forecasting can also help firms make better strategic decisions and more accurate predictions. Load forecasting is even more important in power markets with large (often volatile) renewable components. Renewable forecasts – for constrained demand at least (see below) – will contain additional weather factors in their calculations.

Regardless of timescale (whether short-term, medium-term or long-term], load forecasting calculations cover:

- **Constrained demand**. Relatively simple to calculate, constrained demand forecasts supply potential, taking into account supply-side operational factors and how much energy a supplier can realistically produce.
- **Unconstrained demand**. This forecast takes a more demand-focused approach, essentially forecasting how much consumers will use, regardless of supply-side factors. Because it involves many more factors, it can create considerable computational challenges.

Lightening the load with AI

Firms can apply several calculation methodologies with varying levels of complexity to load forecasting. At the more basic end of the spectrum, simple time-series models can work if there are not too many factors to consider. But for load forecasts with large numbers of factors and data points, one potential solution is to apply AI to the problem.

As we have noted elsewhere[3], rather than being a single tool, AI is a set of statistical processes and algorithms. Several of these are becoming more powerful as computationally aligned infrastructure (in other words, infrastructure built specifically to be used with advanced computational hardware) becomes more popular.

Within load forecasting, the use of neural networks, combined with ML and 'fuzzy logic', can help firms to reduce their computational burden while increasing the number of factors they can consider. This is particularly appropriate when calculating short-term load forecasts, which can contain high levels of uncertainty. But it can also be applied if firms plan to identify relationships between weather factors and load in longer-term forecasts.

Firms can also use neural networks to identify trends in short-term power markets, and ML to calculate the time factors affecting these patterns. 'Fuzzy' neural networks - in essence, ML systems that use neural network techniques to identify the parameters of an otherwise 'fuzzy' system - can also be applied.

One choice among many

Although AI has some strong use cases in load forecasting, it may not always be the best choice. In terms of both hardware and personnel it can be much more expensive than more conventional methodologies. Depending on the exact use case they are addressing, firms can also apply several other methodologies of varying complexity (notably regression modeling).

Those firms planning to develop their load forecasting capabilities should also consider the different programming languages now available. In many energy use cases, MATLAB has historically been the language of choice. But more recent alternatives, such as Julia, are more efficient in handling time-series data, or when interacting with and processing large array databases. Using MATLAB, this type of functionality would require workarounds.

ML and microgrid management

Microgrids[4] are now increasingly common in larger national and regional grid networks. Their capacity to consume and produce power on a small, local scale also makes them intriguing from a trading perspective, creating a situation in which peer-to-peer power trading can occur between separate microgrids. This contrasts with the previous situation, in which electrical power was only really traded to and from large grids.

At the heart of each microgrid lies the microgrid control center (MGCC). This is responsible for monitoring and managing several items and processes: the load (the current power uptake in the grid), distributed generators, energy storage in the network, weather data, and interactions with external grids. In Chartis' view there is strong potential for AI techniques to be used within the MGCC. By using ML, for example, firms can retrieve useful information (such as grid status and forecasts) from the abundance of newly available data (which could be weather data, say, or sensor data from the network).

Predicting the weather

Microgrids are commonly found in small communities with strong local energy generation, and in areas with poor or non-existent main grid connectivity, or those with specific security needs. This production may involve some renewable power.

Current methods for generating renewable power are governed largely by the weather, making them volatile producers. Some firms are using ML techniques to learn more about the optimal distribution of energy based on historical data they have. Some firms now employ ML algorithms in MGCCs to:

- Forecast load and potential power generation.
- Calculate how energy storage should be used.
- Determine whether or not renewable sources should be connected to the main grid to respond to strong peaks and troughs in supply and demand.

Again, new data sources are enabling advanced analytical techniques. ML algorithms would struggle without new data from sources such as weather sensors, IoT devices and metering sensors being integrated into microgrids.

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[3] *See the Chartis report 'Artificial Intelligence in Financial Services, 2019 – Demand-Side Analysis: Exploring the real value in new statistical techniques'.*

[4] *Localized power management networks that can incorporate varied energy resources to allow distributed power to be generated and stored over a small area.*

Conclusion: powering opportunity

Current analytical advances suit energy markets, across trading and operations, helping to optimize processes and identify new opportunities. Tools used in financial services are being adapted to the energy sector, and in many cases match the nuances of this market well. In particular, the abundance of new data sources provides the ideal environment for new analytics, and the number of factors and variables involved in energy demand and supply makes the sector a strong candidate for powerful analytical techniques. And, in the energy sector (as elsewhere), volumes of strong, relevant and useable data are growing steadily.

In Chartis' view, energy firms should consider two key dynamics in this space:

- **Datacenter flexibility**. Maintaining a flexible datacenter is critical, not least because of recent advances in databases, common hardware configurations and computational requirements. Firms with restrictive datacenters in limited configurations risk missing out on the opportunities offered by modern analytical techniques that could help them optimize their trading and operations. Even those firms that are not under pressure now should be aware of the issues that could become more pertinent in future.

- **HPC/Big Data hybrid architecture**. Embracing Big Data can bring benefits – and this is certainly true in the energy space. Firms could improve these benefits by considering how well-aligned their computational capabilities and data infrastructure are. Big Data and HPC are two distinct ecosystems – one way to ensure that the two can be used effectively is to adopt a hybrid architecture that incorporates elements of both.

Sources of new data are creating new opportunities for firms to use energy analytics, but taking full advantage of these can be a challenge that requires careful consideration. Fortunately, new technologies and resources are ensuring that firms throughout the energy industry have options open to them.

By treating advanced analytics as elements of a toolkit to be applied appropriately, and by carefully considering the interplay between analytics and their vital underlying technologies, energy firms can solve many of their problems – by finding new solutions to old ones, and by addressing brand new ones directly.

Chartis plans a series of reports in 2020 analyzing various aspects of energy technology markets, including one focusing on analytics and analytical technologies for the energy trading risk management space.

For more information, contact us on **info@chartis-research.com**.

5. Energy25 2019 rankings

Rank	Company	Overall score	Functionality	Core technology	Market presence/ impact	Innovation	Strategy
1	FIS	**61.4**	62.0	60.0	65.0	60.0	60.0
2	Enverus	**56.0**	43.0	48.0	50.0	65.0	74.0
3	Eka	**55.8**	48.0	56.0	44.0	66.0	65.0
4	Openlink (ION)	**53.3**	52.0	50.0	54.5	54.0	56.0
5	ICE	**53.2**	49.0	45.0	53.0	58.0	61.0
6	Allegro (ION)	**53.0**	56.0	48.0	49.0	56.0	56.0
7	Pioneer Solutions	**48.4**	50.0	47.0	45.0	47.0	53.0
8	CubeLogic	**46.2**	43.0	50.0	41.0	47.0	50.0
9	ZE	**46.0**	48.0	48.0	42.0	50.0	42.0
10	Verisk Analytics	**45.2**	40.0	40.0	50.0	48.0	48.0
11	Lacima	**44.6**	42.0	44.0	36.0	56.0	45.0
12	S&P Global	**44.2**	35.0	36.0	45.0	45.0	60.0
13	Murex	**44.0**	40.0	55.0	40.0	40.0	45.0
14	CTRM Cloud	**43.8**	44.0	50.0	32.0	45.0	48.0
15	Beacon	**43.6**	38.0	55.0	30.0	45.0	50.0
16	TMX	**42.6**	48.0	45.0	40.0	40.0	40.0
17	IHS Markit	**40.4**	30.0	34.0	38.0	48.0	52.0
18	Deutsche Börse	**40.0**	33.0	45.0	36.0	40.0	46.0
19	Brady	**39.8**	37.0	40.0	40.0	38.0	44.0
20	Gen10	**39.4**	36.0	40.0	34.0	40.0	47.0
21	CME	**38.8**	30.0	34.0	36.0	45.0	49.0
22	Triple Point Technology (ION)	**38.0**	46.0	40.0	38.0	36.0	30.0
23	RightAngle (ION)	**37.6**	40.0	38.0	36.0	36.0	38.0
24	BGC	**33.0**	32.0	32.0	32.0	32.0	37.0
25	MicroStep-HDO	**30.8**	34.0	30.0	30.0	30.0	30.0

Top three vendors by category

Rank	Functionality	Core technology	Market presence/ impact	Innovation	Strategy
1	FIS	FIS	FIS	Eka	Enverus
2	Allegro (ION)	Eka	Openlink (ION)	Enverus	Eka
3	Openlink (ION)	Murex/Beacon	ICE	FIS	ICE

6. Appendix A: Research methodology

The rankings in Chartis's Energy25 report reflect our analysts' expert opinions, along with research into market trends, participants, expenditure patterns and best practices. We validated the analysis through several phases of independent verification (see Table 1).

So we can continue to accurately assess the market and its key players, we develop and refine our methodology as relevant markets evolve. Any changes will be reflected in subsequent reports.

Table 1: Energy25 research methodology

• Performed a comprehensive market sweep of leading market participants.
• Completed surveys and interviews with energy risk technology buyers and end users.
• Collected data on organizations' expenditure priorities and vendor preferences.
• Collated 50 completed questionnaires, briefing documents and product specifications from energy risk technology vendors.
• Conducted and attended 50 interviews, product demonstrations and strategy briefings with energy risk technology vendors.
• Conducted 35+ interviews with energy risk technology buyers to validate our survey findings.
• Conducted more than 15 interviews with independent consultants and system integrators specializing in energy risk technology.
• Applied Energy25 assessment criteria to filter the top 50 vendors.
• Reviewed data with 10 independent consultants and 35+ energy risk technology buyers.
• Interviewed ex-employees of the top energy risk technology vendors to validate our findings.
• Undertook final data validation with 40 vendors.
• Completed independent reference checks to validate vendor claims and client satisfaction levels.
• Developed the final top 25 rankings, identified the category winners and finalized the report.

Source: Chartis Research

7. Appendix B: How to read the Energy25 rankings

The Energy25 rankings cover a broad range of vendors in the energy risk and trading arena. These include: providers of energy risk and trading solutions, standalone energy risk providers, providers of data (including market data, operational data and alt-data), data management providers, execution and trading platforms (including exchanges, trading networks, etc.), and providers of clearing and back-office capabilities, regulatory reporting and regulatory management, operational risk and accounting.

Chartis considers the following categories in its analysis: functionality, core technology, strategy, customer satisfaction, market presence, and innovation.

Table 2 details the areas covered by each category.

Table 2: Energy25 assessment criteria

Functionality	• Pricing and modeling (including models for managerial decision-making and operational analytics), risk management and the range of risk measures (including contingent credit risk), trade capture, trade execution capabilities, trade data models and trade data management, logistics support, optimization capabilities, contract management, data management, support for enterprise resource plannning, support for aspects of supply chain management, provision of data (as well as breadth of data provision), value added to data provision (i.e., does the vendor add value to the data it is supplying, or is it a distributor), data interfaces, coherence of functionality, support for specific asset classes across all the above criteria, and economic modeling.
Core technology	• Fundamentals of technology architecture, flexibility of technology architecture, data management framework, computational framework, performance capabilities and scalable data interfaces.
Market presence/impact	• Considering the enormous diversity of market participants and the varied nature of their relationships with their customers, we have created a single index to measure the combined impact of market presence (sales, future expected sales, partnerships, etc.), customer satisfaction, and market impact (strong network effects, embedded components that a variety of industry participants leverage, supplies industry-standard components, supplies across a broad range of customers, etc.)
Innovation	• Broad category that measures new activity, innovative strategies, new quantitative models, thought leadership, new approaches to doing business, and new commercial structures. Vendors with ongoing continuous improvements and tactical innovations generally receive high scores. Overall, some key themes stand out, including a focus on data, a focus on physicals, flexible technical architectures, handling of varied analytics, new quantitative strategies and, above all, digitalization.
Strategy	• For this measure we score vendors based on their approach to the market, go-to-market strategies, ability to execute on their stated strategies, and their ability to mirror market shifts.

Source: Chartis Research

8. How to use research and services from Chartis

In addition to our industry reports, Chartis offers customized information and consulting services. Our in-depth knowledge of the risk technology market and best practice allows us to provide high-quality and cost-effective advice to our clients. If you found this report informative and useful, you may be interested in the following services from Chartis.

Advisory services

Advisory services and tailored research provide a powerful way for Chartis clients to leverage our independent thinking to create and enhance their market positioning in critical areas.

Our offering is grounded in our market-leading research, which focuses on the industry and regulatory issues and drivers, critical risk technologies and leading market practices impacting our sector. We use our deep insight and expertise to provide our clients with targeted market and industry analysis, tailoring content to assess the impact and potential of relevant regulatory and business issues, and highlighting potential solutions and approaches.

Chartis' advisory services include:

Market dynamics

The markets that our clients – vendors, institutions and consultants – address are changing at an ever-increasing pace. Understanding the market dynamics is a critical component of success, and Chartis uses its deep industry and technical knowledge to provide customised analysis of the specific issues and concerns our clients are facing.

Market positioning

In today's highly competitive market, it is no longer enough to simply have a leading product or solution. Buyers must be able to appreciate the differentiating capabilities of your brand and solutions, and understand your ability to help them solve their issues.

Working with our clients, we generate compelling, independent co-branded research, targeting critical business issues. This helps our clients to position their solutions effectively, 'own' key issues, and stand out from the crowd.

Collaborating closely with our clients, we develop pragmatic, resonant thoughtleadership papers with immediate industry relevance and impact.

Our offering includes:

- **Co-branded research** on key market topics to provide a unique and compelling point of view that addresses a key industry driver and highlights the relevant issues. Reports can be tailored to varying levels of depth and can be powered by quantitative survey fieldwork, qualitative industry interviews, our deep domain expertise, or a blend of all three.
- **Chairing roundtables and/or facilitating events and workshops**, to support clients in hosting compelling events that put them at the heart of the discussion.
- **Targeted marketing through our sister brands**, leveraging the power of our parent group – Infopro Digital – to reach across leading brands such as Risk.net, WatersTechnology, FX Week and Central Banking.

Competitor analysis

Our unique focus on risk technology gives us unrivalled knowledge of the institutions and vendors in the sector, as well as those looking to enter it. Through our industry experts, Chartis clients can tap our insights to gain a much deeper understanding of their competitors and the strategies they should pursue to better position themselves for success.

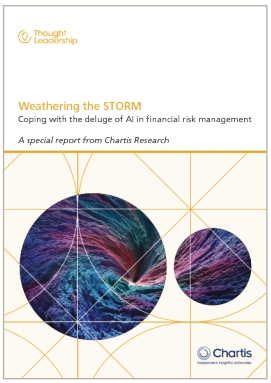
Regulatory impact analysis

The analysis and assessment of regulatory change and implementation is one of Chartis' core strengths. We can apply our insights to assess the impact of change on the market – both as it applies to vendors and the institutions they serve – or on a client's specific product and customer base. We can also provide insights to guide product strategy and associated go-to-market activities, which we can execute for internal use to drive our client's strategy, or as a co-branded positioning paper to raise market awareness and 'noise' around a particular issue.

9. Further reading

Energy Trading Risk Management Systems: Market Update 2017

RiskTech 100 2019



Weathering the STORM

Model Validation Solutions, 2019: Overview and Market Landscape

Global Risk IT Expenditure in Financial Services: 2018 Update

Data Integrity and Control in Financial Services: Market Update 2018

For all these reports, see **www.chartis-research.com**

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