

Born Digital: Designing Future-Proof Operations for Energy Transition

“Digital technologies and data hold tremendous potential to accelerate clean energy transitions across the energy sector” (IEA, 2023). This paper examines how these elements can be put into practice. However, it is essential to clarify **why this topic is crucial for energy companies and consultancies**.

1. Energy at the Core of Decarbonization

Climate impacts are increasingly visible—from longer droughts to heavier rains and faster-spreading wildfires. These events are testing economies and infrastructure in ways that reach beyond the environmental agenda. As the IPCC has warned, the risks are no longer abstract.

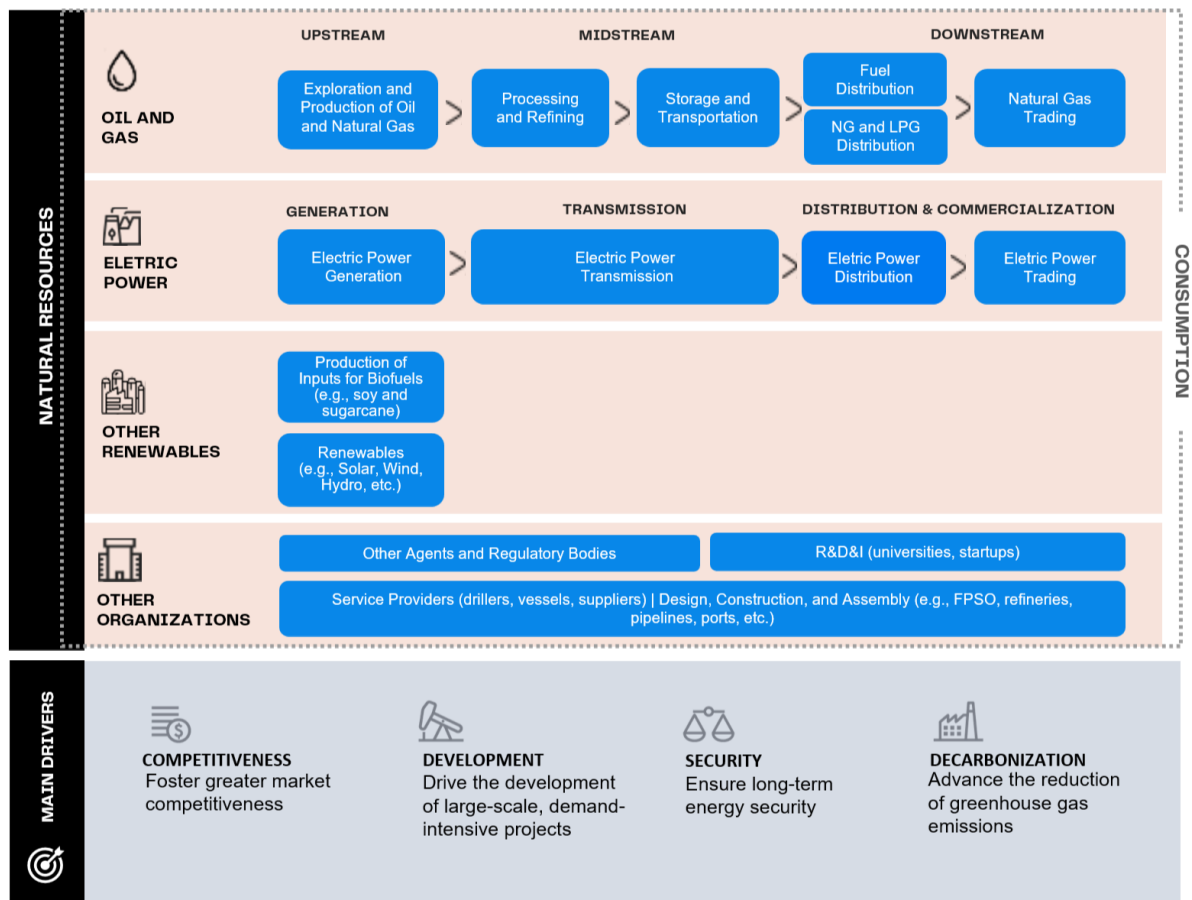
Energy is central here. Producing and consuming it accounts for close to **three-quarters of greenhouse gas emissions** (WRI, 2024). Coal still leads the chart with 45%, followed by oil at 33% (IEA, 2024). No surprise that every major climate negotiation keeps energy at the center of the table.

Back in 2015, COP21 set the goal of staying “well below 2°C.” The 1.5°C target will demand a sharp cut in emissions before 2030. More recently, COP28 (2023) shifted the **spotlight to renewables, calling for a threefold increase in capacity this decade**.

The shift is also economic. The **global market for energy transition may approach US\$6 trillion by 2032** (Maximize Market Research, 2025). That growth is pushing forward new business models – **green hydrogen, biomethane, carbon capture, LNG and BioLNG, and storage technologies like advanced batteries**.

In short, new sources, new players, and new pressures are reshaping the sector. The figure below maps this ecosystem and its main drivers: **competitiveness, development, security, and decarbonization**.

Figure 1 – New Energy Ecosystem & Strategic Drivers



Source: Author's elaboration (2025)

Building resilient operations that can handle diversification, new consumption patterns, regulatory changes, and infrastructure growth makes digital tools essential. Today, resilience means using data to make decisions and relying on integrated technologies for flexibility and compliance. As global pressure increases and new business models emerge, energy companies must become more efficient. This creates a clear opportunity for consultancies to help accelerate progress, develop digital maturity, and turn ambition into real results.

The energy transition is, inevitably, also a digital transition.

2. Technology as Fuel for Energy Businesses - Building Resilient Operations

Companies must define the business and tech vision in parallel. The challenge is that **this alignment between business and technology rarely happens** in practice. Many companies rush into acquiring systems and platforms before designing how they should be used to support business objectives.

A recent case in Denmark highlights the risks associated with this approach. According to inspections reported by the Joint Research Centre (2024), **473 methane leaks were detected**

across 50 biogas plants. The causes ranged from **pipeline defects and maintenance failures to the absence of effective monitoring.** Technology itself was part of the project, but the lack of a well-planned integrated digital architecture – one that could detect failures in real time and enable predictive maintenance – undermined the expected outcomes.

Complex businesses require a planned technology infrastructure from the outset. Companies that are born digital gain a measurable competitive advantage. According to MIT, **digital future-ready organizations report 17 percentage points higher revenue growth and 14 percentage points higher net margin.**

Many companies are ready to invest. Gartner (2025) found that **92% of power and utility firms plan to increase investments in AI and machine learning by 2025.** The real challenge is making these plans work. This is where consultancies are essential, helping companies use technology to build digital maturity and drive business results.

3. Green Energy as Fuel for Technology – Enabling a Sustainable Digital Transition

What if the very technology meant to accelerate the energy transition ends up straining the planet's energy systems instead?

The rise of AI is already pushing electricity demand to new levels. The IEA (2025) projects that global consumption from data centers will more than double by 2030. In the U.S., they already consume over 4% of national electricity and could reach 12% by 2028 (DOE, 2024). AI workloads alone account for about 20% of that demand today and could double by year-end, comprising nearly half of total consumption (WIRED, 2024).

Stopping technological progress is not an option. The question is how to make it sustainable. One path is the growth of **green data centers**, powered by renewables and designed for efficiency. This green market is expected to **expand from USD 79.8 billion in 2025 to nearly USD 296 billion by 2035** (Future Market Insights, 2025). **Companies adopting these facilities already cut energy waste, reduce costs, and lower emissions through renewable integration and advanced cooling** (IBM, 2024).

AI also helps make energy use more sustainable by improving energy management, predictive maintenance, and system optimization—not just in data centers, but in hydrogen, biomethane, and other renewables. The challenges seen in data centers are similar for energy businesses overall. These companies must run their operations in line with sustainability goals. For them, finding this balance is now a key strategy. For consultancies, it is a chance to speed up **Born Digital approaches that make the energy transition both resilient and sustainable.**

4. The Anatomy of a Born Digital Company

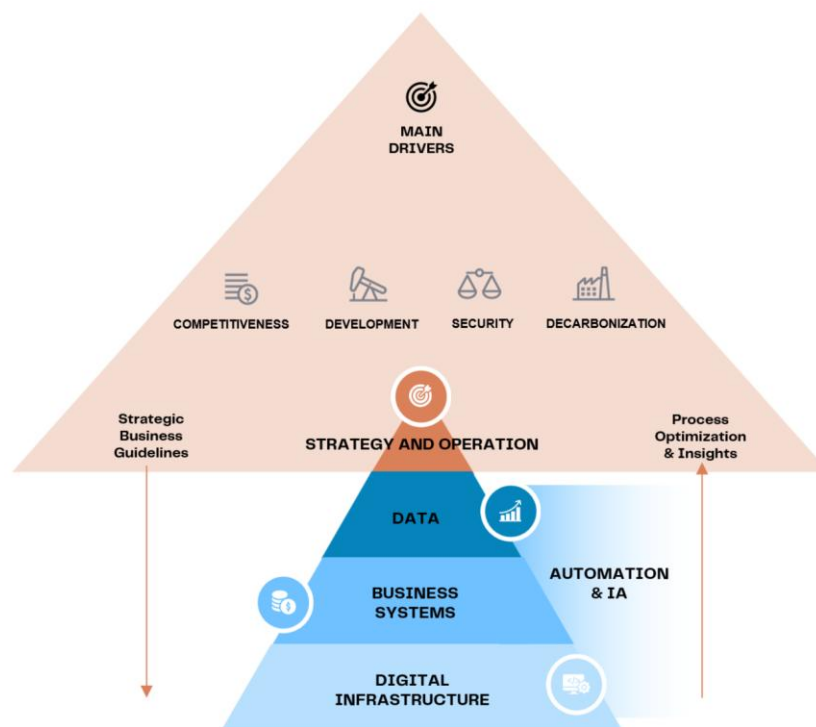
For energy businesses, being **born digital** means more than simply adopting new tools. It means embedding technology from the outset to create value faster, strengthen competitiveness, and use energy more efficiently. Designing operations with a digital lens from day one allows companies to **align strategy and technology** in ways traditional approaches cannot.

These companies connect their strategy and operations directly with technology layers: **Digital Infrastructure, Business Systems, and Data**, all of which enable **Automation & AI**. In this model, the main drivers of competitiveness and sources of value in the energy sector are translated into technological foundations.

Digital infrastructure provides the base to run systems and manage data storage and processing. On this basis, business systems translate strategic objectives into digital processes and coordinate critical operations. From these systems, data is produced, structured, and governed – supporting advanced analytics and insights that feed back into strategy. Automation and AI, working across all layers, speed up the cycle by automating flows, interpreting information at scale, and improving responsiveness.

Anchored in **Enterprise Architecture principles**, this anatomy shows the **interdependence of layers** in simple terms: without infrastructure, there are no systems; without systems, there is no data; and without data, there is no intelligence to leverage.

Figure 2 – Anatomy of a Born Digital Company in the Energy Sector



Source: Author's elaboration (2025)

Being born digital in an emergent market often means starting without the burden of legacy systems, allowing companies to **build flexible technology stacks from the outset**, sometimes with the capacity to support gas and renewables in parallel. The path forward is shaped by infrastructure, fuel options, and local market dynamics. While the approach is adaptable across industries and regions, its core logic remains consistent: what changes are the speed of implementation and the areas of focus, not the fundamental principles.

4.1 Digital Infrastructure

Digital infrastructure forms the backbone of any born digital company. It sustains systems and data, while providing the scale, resilience, and integration needed for effective operations. Instead of a single layer, it rests on two main components:

- **Computing and Storage:** This covers public, private, and hybrid clouds, such as Microsoft Azure, Amazon Web Services (AWS), and Google Cloud Platform (GCP), alongside on-premises or edge setups. Each has a clear role: cloud platforms bring elasticity and cost efficiency, while on-premises and edge remain essential for sensitive data and low-latency tasks.
- **Integration:** APIs, Enterprise Service Buses (ESBs), and platforms like MuleSoft or Boomi connect IT with OT environments. This link keeps data flowing and **creates the base for automation**. *The New Automation Mindset* puts it well: “*There is no automation without integration, and automation is the business outcome of integration.*” In energy, where stacks are fragmented, this need is even greater.

Energy insights for consultants: Companies in the energy sector gain flexibility by mixing their own infrastructure with cloud services, which helps reduce the need for heavy hardware spending (PowerMag, 2024). On-premises setups are still used for sensitive information, while the cloud has been key to cutting energy costs. In this context, consultancies help clients strike the right balance and create a base that sustains the other technological assets.

4.2 Business Systems (Pace-Layered Strategy – Gartner)

The pace-layered strategy divides systems into three different categories: **Systems of Record**, **Systems of Differentiation**, and **Systems of Innovation**. Each plays a different role in turning business strategy into digital processes. The figure below shows their goals, processes, and examples in the energy sector.

Figure 3 – Business Systems by Pace-Layered Logic

 SYSTEM TYPE	 MAIN GOAL	 RELATED PROCESSES	 EXAMPLES
SYSTEMS OF INNOVATION	Enable rapid experimentation and new digital services.	• Testing new consumption and distributed generation models • Demand response pilots • IoT-based monitoring solutions	• Customer engagement apps (consumption, digital invoices, outage notifications) • Demand response pilots • IoT-enabled monitoring.
SYSTEMS OF DIFFERENTIATION	Create competitive advantage with market adaptability.	• Energy trading and risk management • Energy dispatch planning and optimization • Outage response and service continuity • Customer engagement and experience	• ETRM (Openlink, Allegro, Trayport) • EMS • OMS (Oracle Utilities OMS) • Digital Customer Portals
SYSTEMS OF RECORD	Ensure transactional stability and operational continuity.	• Financial and asset management • Customer and contract management • Billing and collections • Real-time asset monitoring and control	• SAP S/4HANA (ERP for billing, finance, asset mgmt.) • Salesforce CRM • SCADA • Oracle Utilities CCB

Source: Adapted from Gartner Pace-Layered Application Strategy

Energy insight for consultants: Business systems are built to digitalize operations, so they have to be planned with the business in mind. The main risk is buying platforms that do not talk to each other, do not reflect key processes, or simply do not fit. Consultancies help connect business needs and technology, bringing a vision of the whole ecosystem and deciding what to tackle first. This view creates a roadmap that solves today’s priorities while leaving room for future growth.

4.3 Data

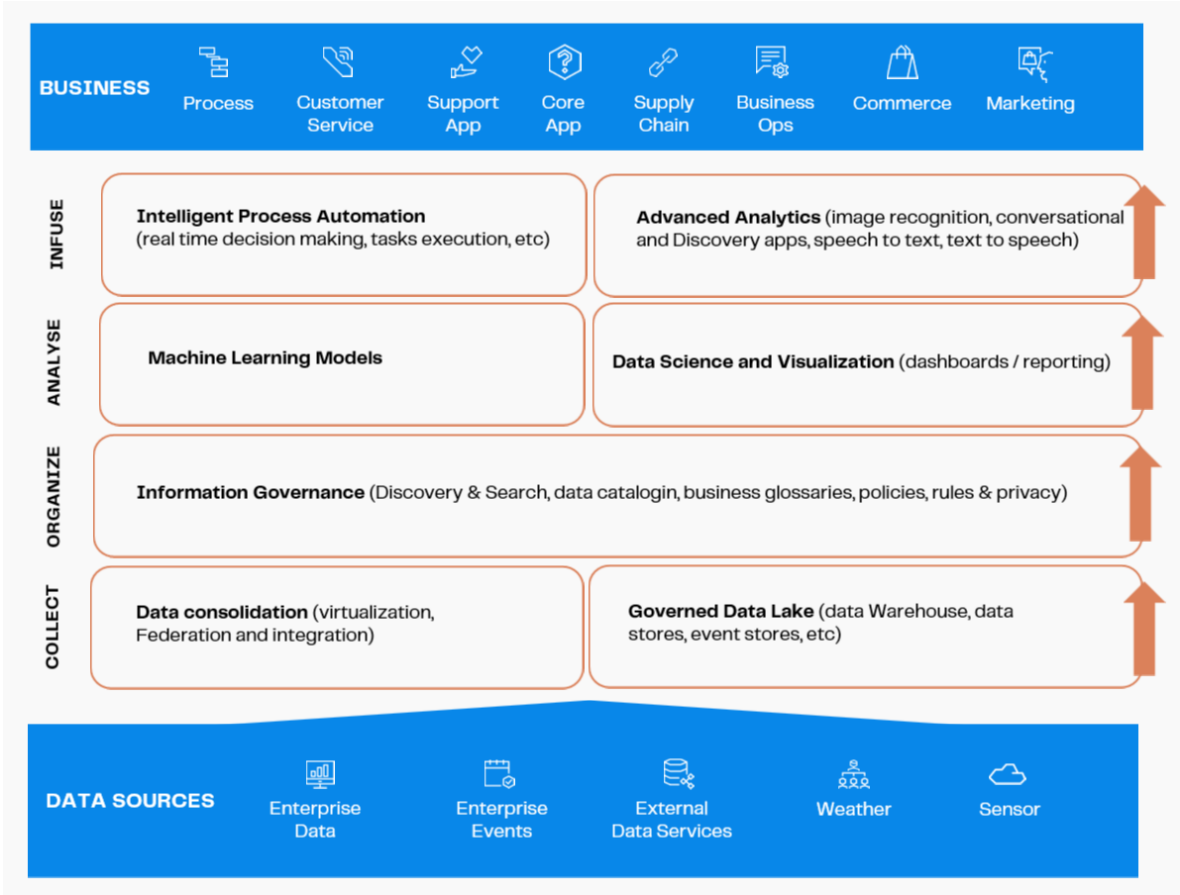
Data is the strategic input that connects systems and enablers. Architectures such as data lakes, data meshes, and data warehouses –combined with pipelines, governance, and security – ensure consistency and reliability. Without high-quality data, automation and Artificial Intelligence (AI) cannot deliver value, as both rely on clean, contextualized, and up-to-date inputs.

It structures the entire cycle of ingestion, curation, analysis, and infusion of insights. IBM’s **AI Ladder** (2019) illustrates this journey: **Collect > Organize > Analyze > Infuse**, showing how raw data becomes actionable intelligence. The same logic applies to Large Language Models

(LLMs) and Small Language Models (SLMs), which function as pattern-recognition engines and depend directly on the diversity and quality of training data (Google DeepMind, 2022).

Figure 4 illustrates this logic, showing how data evolves from collection to infusion into business processes.

Figure 4 – AI Ladder: Data Architecture as the Foundation of Artificial Intelligence



Source: Adapted from IBM Cloud Architecture Center

Energy insight for consultants: In energy, critical data comes from many sources – SCADA, IoT devices, contracts, network sensors, market platforms, and so on. Making sense of all this requires hybrid setups. A lakehouse brings governance and traceability. Streaming handles real-time delays. Moreover, where maturity allows, a federated mesh spreads responsibility across domains. This view is in line with the *Big Data Reference Architecture for the Energy Sector* (Wehrmeister et al., 2025), which stresses multilayered designs for secure and reliable data exchange, covering both historical analysis and real-time flows.

In short: a lakehouse secures governance, a mesh distributes ownership when ready, and streaming cuts latency. Used together, they improve resilience, interoperability, and efficiency in dynamic energy markets.

4.4 Automation & AI

Automation and AI act as accelerators in energy businesses, cutting repetitive work, making processes faster, and expanding analytical capacity.

- **Intelligent Process Automation (IPA):** Automation began its trajectory with Robotic Process Automation (RPA), which was limited to repetitive, rules-based tasks, but has now expanded this scope by incorporating machine learning (ML), intelligent workflows, and cognitive agents—enabling real-time decision-making under the concept of IPA. In the energy sector, this translates into predictive maintenance triggered by SCADA and IoT data, or automatic adjustments in energy dispatch according to variations in load and price.
- **Advanced Analytics:** AI also enables advanced analytics by working through large sets of data to predict events, run scenarios, and back up strategic decisions. This layer touches the whole system's architecture: it helps keep Systems of Record reliable (e.g., anomaly detection in smart meters), improves competitiveness in Systems of Differentiation (e.g., dynamic pricing in ETRM), and supports innovation in Systems of Innovation (e.g., generative AI for demand and market simulations).

Energy insight for consultants: Companies need support to understand the real use cases of these capabilities and to identify which ones align with their reality. To help organizations build this advanced digital capability, consultants must know the practical applications of Automation and AI in the energy industry. The following cases illustrate the potential of these technologies and how they can be applied in practice:

4.4.1 Tata Power-DDL – Integrated Grid Management

In North Delhi, Tata Power-DDL serves 1.64 million customers in one of India's toughest networks, with peaks above 1,900 MW. Outages were frequent, and the company needed a new way to manage complexity. The answer was an Advanced Distribution Management System (ADMS). By bringing together SCADA, OMS, and DMS in a single platform, operators gained centralized, real-time control of the grid.

The impact was clear. Reliability improved, failures dropped, and environmental performance followed. The system now saves more than 26 million kWh each year and avoids roughly 448 kilotonnes of CO₂. Financially, the utility cut costs by about INR 177 million annually. With these results, Tata Power-DDL became the first utility in Asia to receive PEER Gold Certification.

4.4.2 National Grid ESO – AI for Weather Forecasting

The UK's grid operator, National Grid ESO, faced another type of complexity: renewables. With more solar and wind on the system, forecasting became critical. Working with the Alan Turing Institute, the operator tested new AI and machine learning models. These models blended data on temperature, radiation, and weather history, running them against 80 different forecast scenarios.

Accuracy improved by around one-third. That change may sound small, but it made a big difference: lower bills for consumers, more solar connected to the grid, and a step closer to the goal of a zero-emission electricity system.

4.4.3 Predictive Maintenance in Wind Turbines

Wind farms promise clean energy but often face high operating costs. Failures in turbines, especially bearings and gears, were expensive and disruptive. To address this, researchers from i-EM and the University of Pisa developed an AI model for predictive maintenance, trained on SCADA data and tested in real time on 150 turbines in Italy and Romania.

The model spotted failures up to two months in advance. Out of 25 anomalies detected, operators confirmed more than 90% as accurate. For wind operators, this means fewer unplanned shutdowns, longer equipment life, and lower maintenance costs – a significant gain in competitiveness.

Takeaway: These examples show that automation and AI are now embedded in the anatomy of the business. They improve grid reliability, make renewables more predictable, and reduce maintenance costs. For consultancies, the mission is to guide clients in choosing the proper use cases, prove their impact, and scale them across the business.

5. What Is Truly Possible – Opportunities and Limits of AI in Energy

The excitement around AI in energy is justified, but not every application creates value straight away. This raises fundamental questions: **What can AI actually do today? Where is it already paying off? What obstacles still hold it back?** To explore this, three angles are proper: where AI accelerates energy technologies, how it applies across sectors, and which barriers still block progress.

The following insights are drawn from the IEA's *Energy and AI* study (2024).

5.1 Potential to Accelerate Technologies

The IEA compares technologies using four criteria: solution complexity, data availability, pre-deployment verification, and scalability. This framework helps decision-makers see where AI can deliver results quickly and where groundwork is still needed.

Figure 5 - Illustrative assessment of the potential for AI to accelerate progress against selected key energy technology challenges

Technology challenge	Solution space complexity	Structured data availability	Pre-deployment verification	Integration and scaling
Synthetic fuels - Catalysts with high efficiency, selectivity and stability	●	●	●	●
Hydrogen electrolysis - Low-cost, highly efficient and durable electrolyser catalysts	●	●	●	●
Carbon capture, utilisation and storage - Stable CO ₂ capture materials with high affinity and low energy penalty	●	●	●	●
Electric vehicles - Novel battery chemistries using cheap materials (e.g. sodium-ion, solid-state)	●	●	●	●
High-temperature heat storage - Stable phase change materials with high conductivity and latent heat	●	●	●	●
Desalination - Productive, stable and energy efficient reverse osmosis membranes	●	●	●	●
Advanced biofuels - Improved performance of enzymes and yeasts for 2 nd /3 rd generation biofuels	●	●	●	●
Solar photovoltaics - Efficient, stable, scalable perovskite cells without critical mineral inputs	●	●	●	●
High-temperature heat pumps - Identification of working fluids which phase change at high temperatures	●	●	●	●
Long-duration energy storage - Cheaper, efficient redox-flow or other long-duration batteries	●	●	●	●
Decarbonised cement - Cement production from calcium silicate raw materials	●	●	●	●
Plastics recycling - Energy-efficient upgrading of pyrolysis oils	●	●	●	●
Effective nuclear fusion - Fusion reaction control	●	●	●	●

● High ● Medium ● Low

Note: Green indicates a high degree of alignment between the criteria and the technology challenge, suggesting AI is more likely to have meaningful impact in the sector; orange indicates some alignment, and that innovation in the sector could benefit from AI; red indicates low alignment, suggesting a possible hurdle to AI deployment.

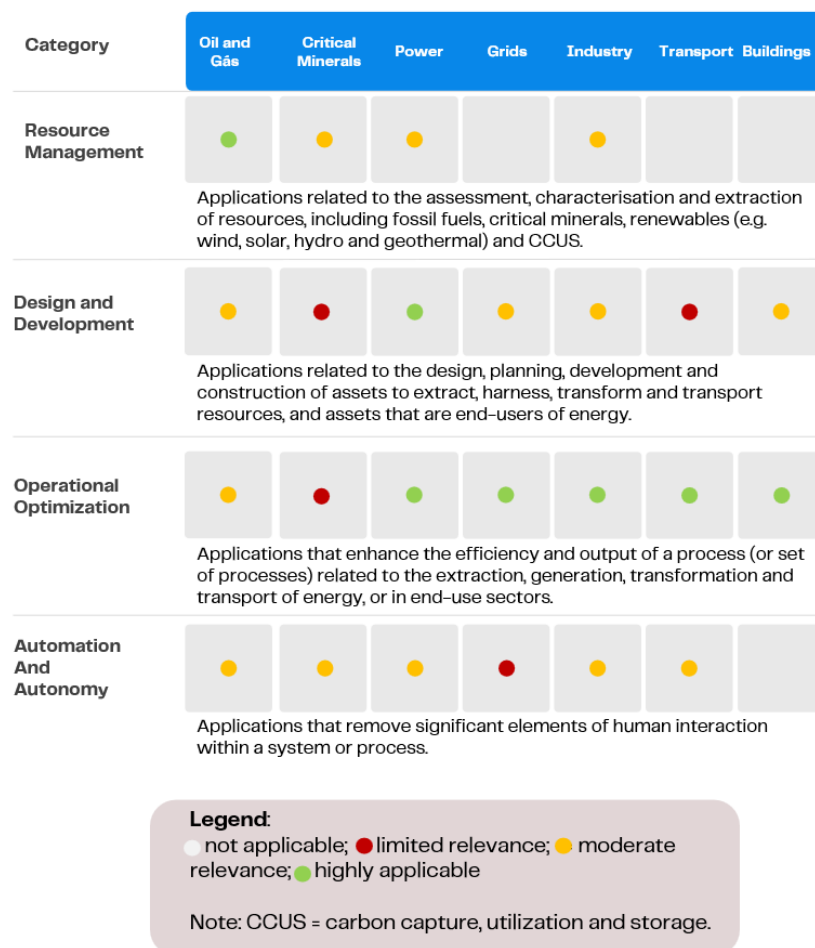
Source: World Energy Outlook Special Report – IEA (2024)

- Some technologies are poised to move quickly with AI – hydrogen, carbon capture, and new battery chemistries stand out because they combine complexity with rich datasets and the ability to test solutions efficiently. Others, where data is scarce or institutions are not yet in place, will need groundwork first. The message is simple: **invest in the foundations where they are missing, and double down on advanced applications where the basics already exist.**

5.2 Applicability Across Sectors

The report also maps AI uses—resource management, design & development, operational optimization, and automation/autonomy—across different parts of the energy chain.

Figure 6 - AI applications for energy optimization and their applicability by sector



Source: World Energy Outlook Special Report – IEA (2024)

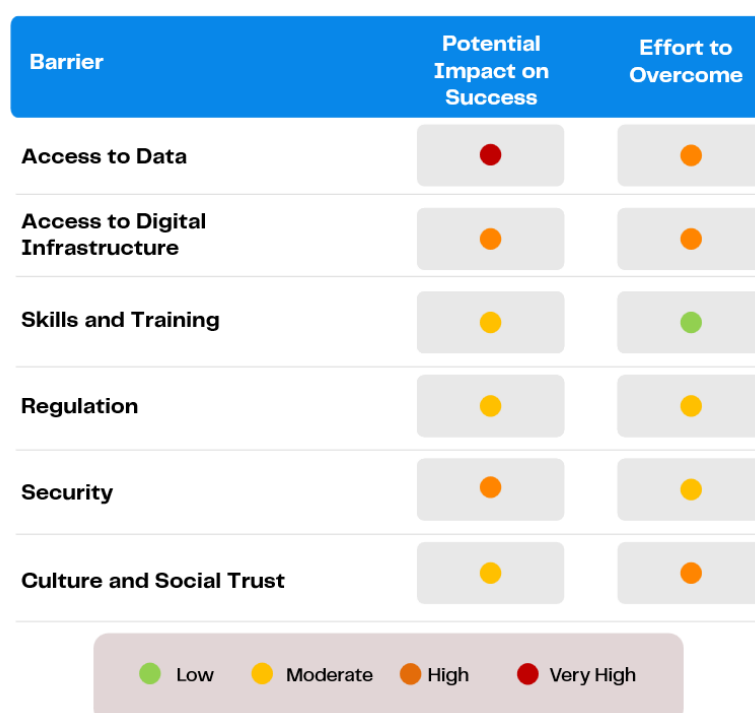
- Looking at the energy chain, one thing is clear: **operational optimization is the most advanced application of AI today**, already delivering impact across almost all sectors.

For companies, **the priority should be to capture quick efficiency gains** while also preparing for the next frontier of differentiation – automation and the digital design of energy assets.

5.3 Structural barriers limiting its adoption

Finally, Barriers are ranked both by the effort to overcome them and the impact they have on success. This analysis helps us understand why so many initiatives remain limited and why efforts should be directed toward activating potential.

Figure 7 - Potential barriers to the adoption of AI applications in energy



Source: World Energy Outlook Special Report – IEA (2024)

- **The main bottleneck is access to quality data**, which has a very high impact and requires a great deal of effort to overcome. Digital infrastructure and skills/training also emerge as relevant issues that require continuous investment. Issues such as regulation, security, and social trust can be overcome through coordination between key stakeholders. Therefore, the recommendation is that **companies need to invest in data governance and integration**.

In sum, AI already delivers tangible value (maintenance, loss management, dispatch). GenAI unlocks unstructured content, but data governance and integration set the ceiling for value. The

role of consultancies is to convert recommendations into roadmaps, anchor data governance, and synchronize strategy, architecture, and execution.

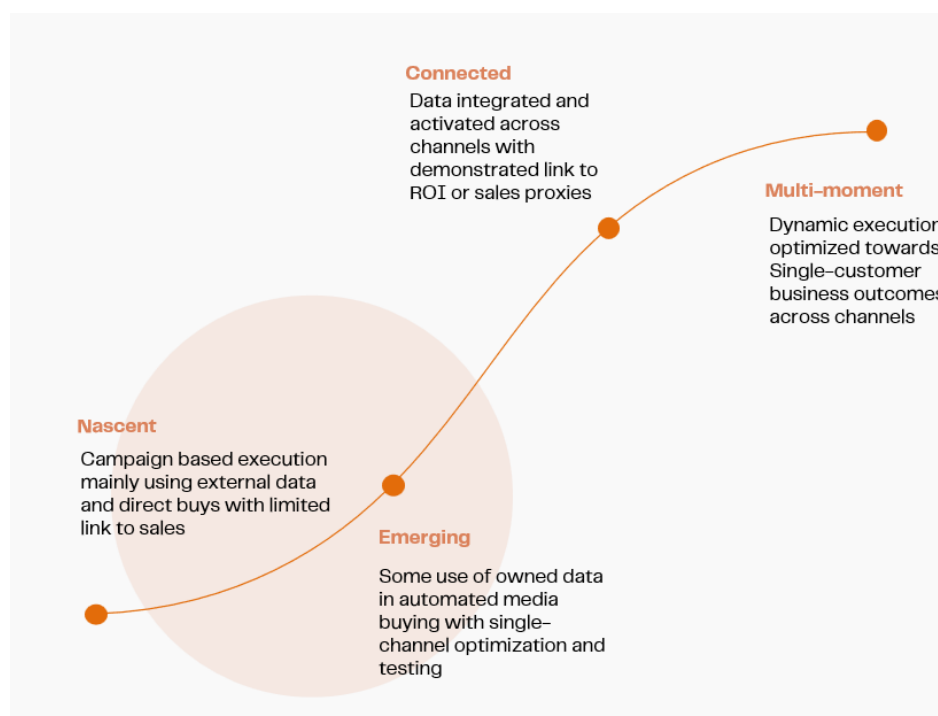
6. Consultancies Accelerating Businesses that Accelerate Energy Transition

6.1 The Challenge of Digital Maturity

As highlighted in the previous section, the use of AI and other technologies still faces significant barriers in energy companies. That is why, before proposing any solution, it is essential to **understand each organization's digital maturity**.

The new business models emerging in the energy sector come from either startups born with sustainability at their core or from incumbents shifting toward cleaner operations. In both cases, digital maturity tends to be limited. Using the maturity stages as a reference, most of these organizations can be interpreted as falling within the “**Nascent**” or “**Emerging**” categories.

Figure 8 – Digital Maturity Stages



Source: Digital Maturity Stages (2021)

Companies in the “Nascent” stage are typically still being set up, lacking core systems and operating with minimal digitalization. “Emerging” organizations go a step further, beginning to structure data and experiment with basic automation, but without scale.

In this context, consultancies **help companies to move faster along the maturity curve** – delivering short-term results while laying the groundwork for long-term evolution. This is the

paradox of Vision vs. Foundation: Successfully transforming into growth requires setting out a long-term vision for the firm. However, it also means building the foundations in the short term that enable delivery on that vision.

6.2 Designing Future-Proof Operations for Energy Transition

After diagnosing where energy players stand in terms of digital maturity, the next step is to design operations that are resilient, scalable, and aligned with the demands of the energy transition – that is, truly future-proof. The “**Designing Future-Proof Operations**” approach was developed through a consulting lens, inspired by methods such as Continuous Discovery, Enterprise Architecture (TOGAF), C4, SAFe, Agile Delivery Management, and the Future Back Approach. The goal is clear: help companies move from vision to execution, ensuring that each digital investment strengthens strategy while delivering measurable value.

The starting point is strategy: consultants must have a clear view of the company’s goals and ambitions. Every digital initiative should tie directly to these strategic drivers. From this alignment, value hypotheses guide the technology stack and decision-making throughout the journey. Execution then unfolds across three stages:

- **IA. Business Model Exploration** – Understand the business context and operational journey, mapping challenges and opportunities to define value hypotheses that will shape technology solutions.
 - *Key deliverables:* process map, business requirements, prioritized value hypotheses, success indicators.
- **IB. Architecture Design (Digital Anatomy)** – Translate business understanding into an integrated architecture, specifying systems, domains, flows, integrations, and components to ensure scalability and interoperability.
 - *Key deliverables:* technology requirements, infrastructure/data/systems architecture, automation & AI use cases, phased roadmap.
- **II. Delivery Management** – Plan and prioritize across multiple implementers, coordinate technology teams, manage change, and track KPIs, ensuring each release delivers incremental business value.
 - *Key deliverables:* updated requirements, resolved gaps, change log, integrated test scenarios.

For this approach to succeed, the continuous involvement of operations and technology teams at all stages is essential to ensure consistency between strategy, architecture, and execution. A

common mistake is to restrict the term “business area” to operations alone. **The correct mindset must recognize that technology is part of the business and inseparable from it.**

With this in place, the framework ensures that born digital implementations in the energy sector are not a patchwork of isolated initiatives, but a structured path where each release delivers measurable results while laying the foundations for long-term competitiveness.

6.3 Bringing Automation and AI into “Nascent” and “Emerging” Companies

The first rule is simple: do not skip steps. In low-maturity organizations, the consulting role is primarily educational. The IEA (2024) indicates that nearly a quarter of companies fail to **progress in AI initiatives due to a lack of internal expertise**. This reveals that many firms still miss even the basics, making **consultants essential as cultural change agents** who instill a data-driven mindset and openness to experimentation.

At this stage, recommendations should focus on **building a minimal architecture for quick wins**. Early results prove value, build trust, and create momentum for future evolution.

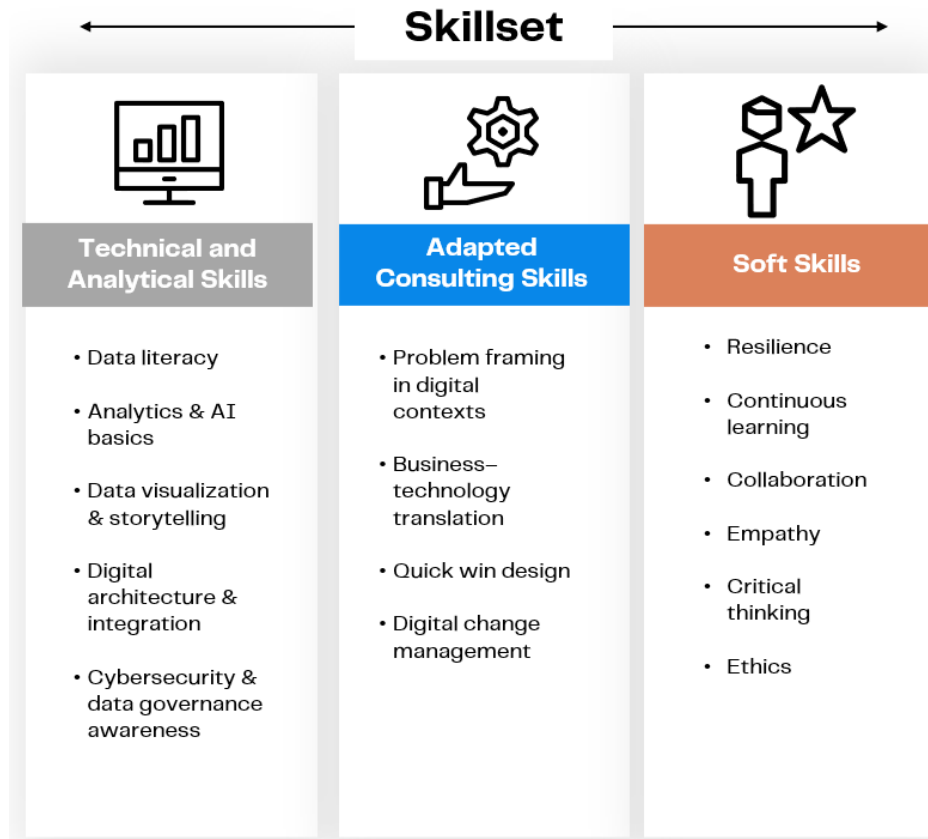
Quick wins at this point are **less about advanced automation and more about digitalizing manual processes** – such as volumetric and financial reconciliations, operational checklists, or invoice processing. By streamlining these activities, employees gain time for more strategic work, while the organization builds the conditions for its first automations to generate tangible business value.

6.4 Shaping the Consultant of the Future

For clients navigating the complexity of the energy and digital transition, consulting firms must adapt quickly. **Traditional capabilities remain useful, but need to be reframed through data and digital technologies**. According to the Consulting Skills for 2030 report (CMCE, 2023), AI, big data, and cybersecurity will define the consulting profession – actually, it already is. Still, the report stresses a crucial point: trust is built not by technology alone, but by consultants who bring ethics, empathy, and critical thinking to the table.

Bringing these perspectives together, the figure below summarizes three critical dimensions of the consultant's skill set.

Figure 10 – The New Consulting Skillset



Source: Author's elaboration (2025)

6.5 From Knowledge to Practice: Cordence as a Global Network

Skills like these are not built through experience alone; they grow through exchange. As the philosopher and educator John Dewey put it, “*We do not learn from experience... we learn from reflecting on experience.*” And in consulting, that reflection is far more powerful when it happens collectively. **Progress comes from sharing lessons, debating perspectives, and turning insights into better ways of working.**

This is where Cordence plays a vital role. With more than 5,500 consultants worldwide, it provides a platform for that exchange, where practices tested in one market can inform another, and where reflection turns into actionable insight. **This collective learning raises the standard of our projects and enables us to deliver greater value to clients.**

The case that follows is one example of how reflection and exchange move from principle to practice.

7. Four Years and Three Months – An Invitation to Energy Transition Leaders

The energy transition is inseparable from the challenge of decarbonization. This moment calls for consultants to go beyond advising, acting as leaders who bridge vision and execution

From the analysis in this paper, seven imperatives emerge for those driving the transition:

1. **Engage with emerging businesses** – Support new players in the energy transition market, helping them build resilient and scalable models from the start.
2. **Translate ambition into execution** – Ensure digital and energy strategies move together, turning long-term visions into operational reality.
3. **Adopt the Born Digital stack deliberately** – Align infrastructure, business systems, data, and AI as interdependent layers, not isolated tools.
4. **Focus where ROI is proven** – Begin with operational optimization and progressively move toward advanced automation and AI.
5. **Sequence for quick wins** – Use high-impact cases to fund and de-risk the roadmap.
6. **Leverage global peer learning** – Tap into the Cordence network to peer-review designs, share playbooks, and transfer lessons across markets.
7. **Build the flywheel** – Each proven business line creates proof points for the next; use every success to scale Born Digital across the portfolio.

The transition is both energy and digital. By taking the lead, consultancies accelerate businesses that accelerate the transition itself – turning urgency into execution, and execution into lasting impact.

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