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Hemado GESCA

ChatGPT

What does it really mean for Energy Industry

In a nutshell

Author: Victor Liu, PhD.

ChatGPT-like AI will transform the energy industry

Rapidly evolving general AI programmes will have both short- and long-term impacts on energy company operations, decision-making and innovation

In the energy sector, early adopters are already benefiting from AI solutions such as production optimisation and predictive maintenance. Now, with the introduction of ChatGPT, a powerful AI chatbot, further opportunities are opening up for the energy industry. This deck provides a brief overview of ChatGPT and its potential impact on the sector. Here are the 7 key points:

1 General and generative AI

ChatGPT represents a new type of AI, capable of generating content across various domains. This generative, general AI is different from the predictive, domain-specific AI programmes currently used in the energy sector.

2 Human-like capabilities & vast knowledge base

ChatGPT has advanced neural networks and an extensive knowledge base that enable human-like communication, understanding, reasoning, creativity and problem solving.

3 Limited reliability in high-stake situations

As a general language model, ChatGPT has limitations such as inaccuracies and limited domain-specific capabilities. It may not have a direct impact on oil, gas or renewable energy operations for the time being.

4 Rapid evolution with transformative potential

ChatGPT is rapidly evolving and becoming more powerful, integrated and versatile. It has the potential to transform operations, decision-making and innovation in the energy industry.

5 Short-term supportive role

ChatGPT-like programmes can improve internal and external communication, data analysis and decision-making in the short term.

6 Midterm one-stop shop

In 3-5 years, enterprise-specific chatbots could integrate internal data and digital applications and enable seamless collaboration and communication between IoT systems, departments and teams.

7 Long-term transformation

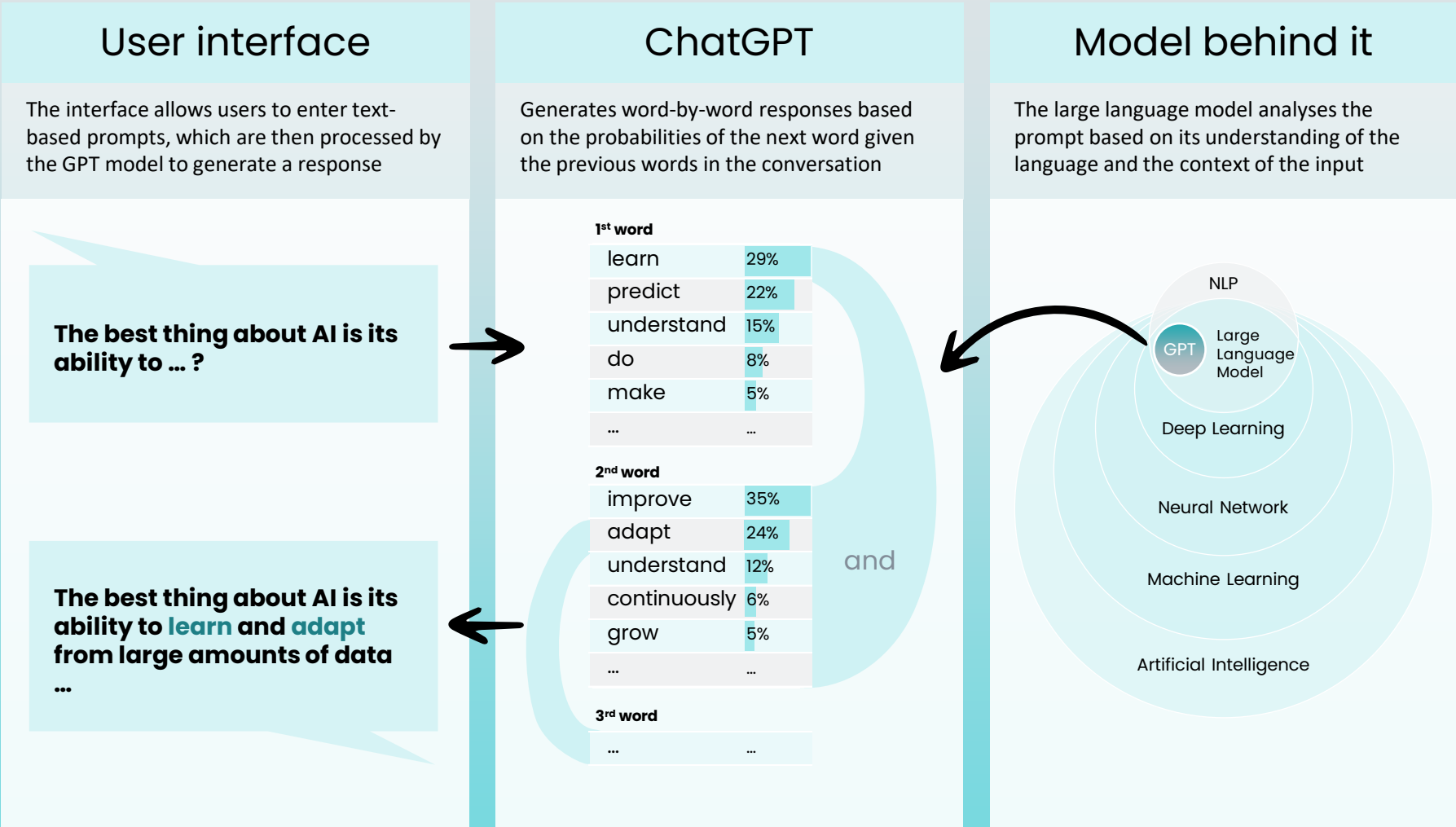
General AI can drive integration across energy systems, support complex problem-solving, promote sustainability, enable autonomous control, and foster new business models and services in the long run.



① ChatGPT

ChatGPT is an AI chatbot trained with massive data

Able to generate human-like responses to given prompts in a conversation



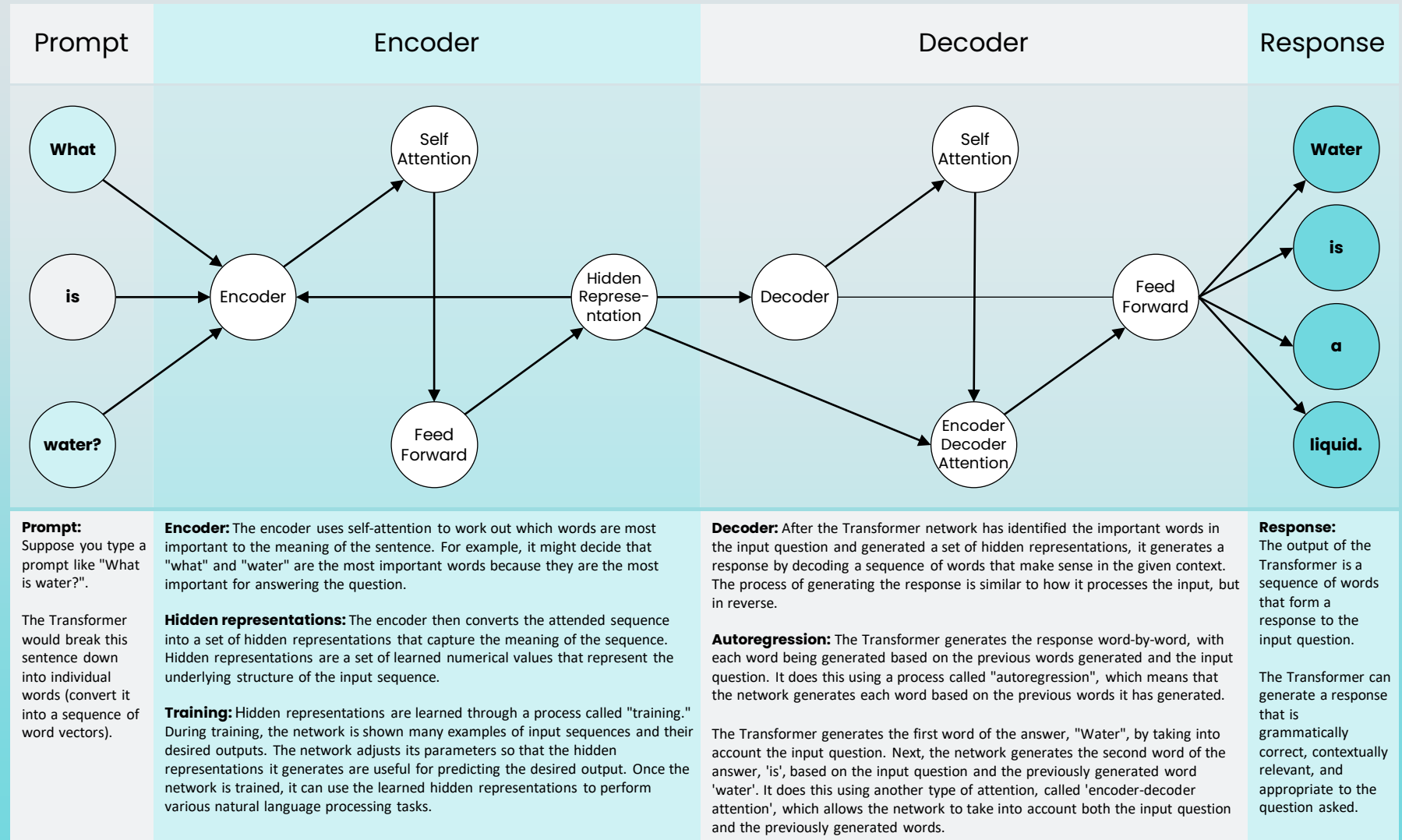
ChatGPT is based on the pre-trained GPT model,

the core of which is the Transformer, a Large Language Model (LLM)

| | ChatGPT The product | GPT The model | Transformer The architecture | LLM The method |
|--------------------|---|--|---|---|
| What does it do? | Fine-tuned to generate human-like, high-quality responses in conversations on a wide range of tasks | Has a large human knowledge base & is able to generate coherent and contextually relevant text | Able to efficiently analyse the entire long sequence of inputs to generate an output | Trained on large amounts of data to generate natural language responses to diverse inputs |
| What's it Good at? | <ol style="list-style-type: none"> 1 Human-like conversation Can write code, write essays, answer questions & make jokes like a human being 2 In-context understanding can be conditioned to perform tasks based on context contained within conversation 3 Versatile extensions APIs and Plug-ins enable ChatGPT to interact with various software | <ol style="list-style-type: none"> 1 Vast knowledge base Enables it to understand and generate responses across a wide range of subjects 2 Context awareness Maintain context throughout a conversation 3 Beyond language Coding, computing, visualisation, etc. | <ol style="list-style-type: none"> 1 Self-Attention Focus on important words weigh the importance of each word in a sequence 2 process long sequence Rather than relying on a fixed-length context window like previous models 3 Parallel attention Multi-head attention that enables it to attend to different subspaces in parallel | <ol style="list-style-type: none"> 1 Response generating Generate a string of words by predicting which word would best follow the previous 2 Contextual understanding Identify the ways that words relate to one another 3 Perform various tasks Surpass average human level |
| Based on what? | <ol style="list-style-type: none"> 1 RLHF Reinforced learning with human feedback 2 Model fine-tuning Content filters or moderation systems 3 Interface engineering Reinforced learning with human feedback | <ol style="list-style-type: none"> 1 Pre-training with vast data GPT-3.5 trained on 175 billion parameters 2 Multimodal learning With data such as text, images and code 3 Model refinement e.g. only one multi-layer decoder structure | <ol style="list-style-type: none"> 1 Attention mechanism Focus on different parts for each token 2 Positional encoding Encode position of each token in sequence 3 Autoregression Generating responses word-by-word | <ol style="list-style-type: none"> 1 Deep learning Teach computer to learn & solve problems 2 NLP Neuro-linguistic programming 3 Large data training Review large data to identify relationships |
| Concept introduced | 2020 "Language Models are Few-Shot Learners" by Brown et al. | 2018 "Improving Language Understanding by Generative Pre-Training" by Radford et al. | 2017 "Attention Is All You Need" by Vaswani et al. | 1980s Early models such as RNN and LSTM |

Transformer transforms a sequence of words into another

It understands the context of a prompt and generates an appropriate response



ChatGPT has a picture of the world, but it's a fuzzy one

As a language model, it has natural limitations in tasks such as arithmetic

Limitations in calculations,

As a language model, ChatGPT and other models work like the human brain, which is not optimised for performing large numbers of calculations. Therefore, when given a random calculation task, it is likely to produce inaccurate answers.

Model: GPT-4

User: $778934 * 989524 = ?$

The product of 778934 and 989524 is 770621610216.

778934 × 989524 =

770,773,887,416

| MC | MR | M+ | M- | MS | M~ |
|-----|----------------|----|----|----|----|
| % | CE | C | ⊗ | | |
| 1/x | x ² | √x | ÷ | | |
| 7 | 8 | 9 | × | | |
| 4 | 5 | 6 | - | | |
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code execution,

ChatGPT is capable of generating code based on user requirements. However, it is important to note that as a language model, it cannot execute the code or guarantee its functionality.

I understand your requirements and will redesign the code to create a clearer and more appealing visualization of the GPT architecture. Here's the Part 1 of the updated code:

```
python
import networkx as nx
import matplotlib.pyplot as plt
from transformers import GPT2Tokenizer, GPT2LMHeadModel
from matplotlib.patches import FancyArrowPatch

# Create the directed graph object
G = nx.DiGraph()

# Load GPT-2 model and tokenizer
model = GPT2LMHeadModel.from_pretrained("gpt2")
tokenizer = GPT2Tokenizer.from_pretrained("gpt2")

# Example input and output
input_text = "What is water?"
output_text = "Water is a liquid."

# Tokenize input and output
input_tokens = tokenizer.tokenize(input_text)
output_tokens = tokenizer.tokenize(output_text)

# Add input and output tokens to the graph
for token in input_tokens:
    G.add_node(token, label=token)
for token in output_tokens:
```

and detailed queries

Although ChatGPT has an extensive knowledge base, it may provide confident but inaccurate answers when faced with detailed questions relating to niche energy sectors.

Model: GPT-4

User: What's the average vessel day requirements of SOV and CTV per turbine per year?

The average vessel day requirements of Service Operation Vessels (SOVs) and Crew Transfer Vessels (CTVs) for offshore wind turbines can vary depending on factors such as the size and location of the wind farm, turbine capacity, distance from shore, weather conditions, and specific maintenance requirements.

As a rough estimate, it is common to see CTVs perform between 100 to 300 transfers per turbine per year, with each transfer taking around 1 day. This results in an average of 0.3 to 0.8 vessel days per turbine per year for CTVs.

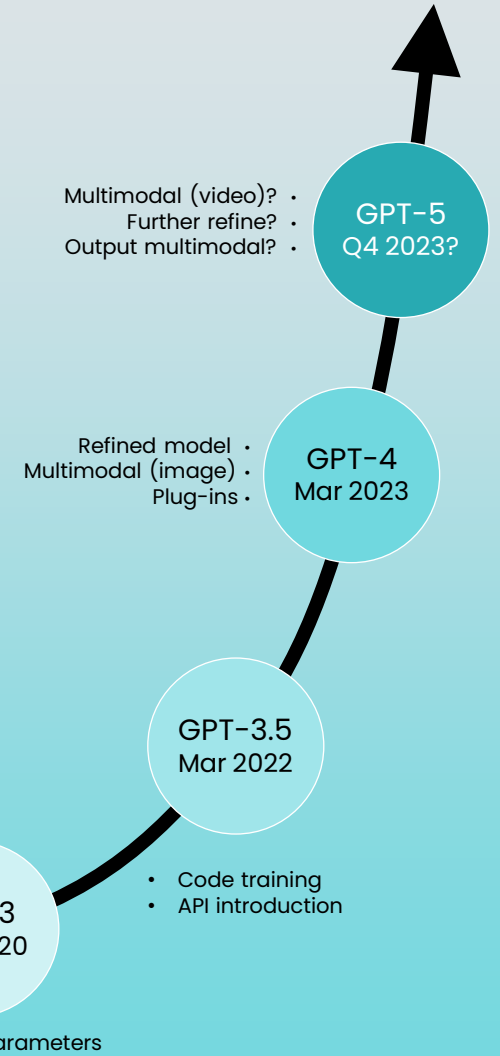
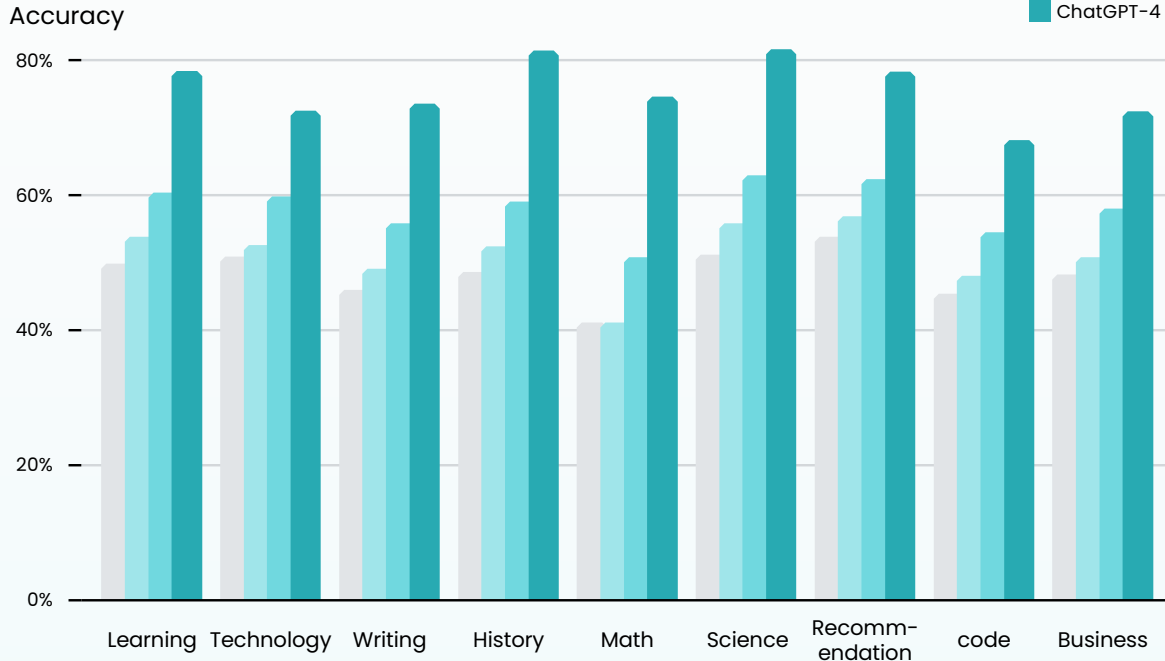
For SOVs, the vessel day requirements are higher, as they usually serve as accommodation and work platforms for maintenance crews. SOVs can be stationed at an offshore wind farm for weeks or even months at a time, depending on the project's size and complexity. A typical estimate for SOV vessel days can range between 1 to 3 vessel days per turbine per year.

Please note that these are rough estimates, and the actual vessel day requirements can vary significantly based on the factors mentioned earlier.

So it is not yet fully reliable in high-stakes situations

But it's rapidly evolving with new versions approaching expert level in various fields

OpenAI's internal factual evaluation by category



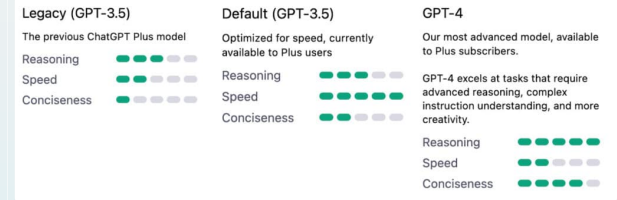
However, it is rapidly evolving to overcome its limitations

Tech giants like Microsoft and Google are all in for a ChatGPT-like AI race



More powerful

ChatGPT and its competitors, such as Bard and Claude, are evolving at a rapid pace, with each new version overcoming previous limitations and expanding its capabilities. The March release of Bing Chat, with its Internet connectivity and source annotation features, and the subsequent launch of multimodal ChatGPT 4, are paving the way for powerful AI.



More integrated

Through the introduction of APIs, Office integration and plug-ins, ChatGPT is creating an AI system that facilitates collaboration between multiple applications and enhances its capabilities. With further development and integration of domain-specific knowledge, ChatGPT can eventually contribute to more specialised tasks in the energy sector, such as optimisation algorithms or predictive maintenance.

Plugin store



Bring your trip plans to life – get there, stay there, find things to see and do.



Search and compare prices from thousands of online shops



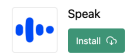
Allows you to search for restaurants available for booking dining experient



Order from your favorite local grocery stores.



Search flights, stays & rental cars or get recommendations where you can go on your budget.



Learn how to say anything in another language with Speak, your AI-powered language tutor.



More versatile

ChatGPT will continue to develop the ability to process and generate output based on multiple modalities such as text, images, audio and video. This will enable the AI model to better understand and create content in different formats, thereby enhancing its overall capabilities.



Textual



Visual



Video







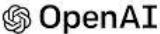


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② Impact on the energy industry

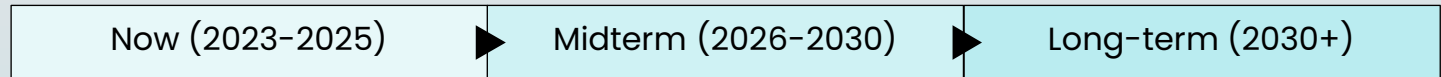
ChatGPT represents a new breed of AI for energy industry

It's generative & general, as opposed to the predictive, narrow AI widely used today


| | Narrow AI | General AI | | |
|------------|---|---|--|---|
| Predictive | <p>Narrow & Predictive AI</p> <p>Widely used in the energy industry</p> <p>Specialised in performing specific tasks and analysing historical data to make predictions</p> <ul style="list-style-type: none"> • Predictive maintenance • Wind power forecasting • Load forecasting algorithms ... <p> sparkcognition[™]</p> <p>IBM Maximo[®] Predict</p> <p>TACHYUS</p> | <p>General & Predictive AI</p> <p>Emerging. Limited adoption</p> <p>Able to learn & understand various tasks and analyse data from various domains to make predictions</p> <ul style="list-style-type: none"> • Multi-task energy system forecast • Multi-domain anomaly detection • Integrated grid management ... <p> DeepMind</p> | <p>Strong AI (AGI)</p> <p>Theoretical, but transformational</p> <p>Strong AI, also known as AGI refers to artificial intelligence that is capable of understanding, learning, and applying knowledge across a wide range of tasks, similar to human cognitive abilities</p> <ul style="list-style-type: none"> • Multi-domain optimisation: Simultaneously optimising energy production, distribution, and consumption across energy sources • Advanced energy system modelling: Predicting and simulating complex energy systems with high accuracy, enabling better planning & decision-making. • Rapid innovation: Accelerate the development and deployment of novel energy technologies through AI-driven research and development ... |  |
| Generative | <p>Narrow & Generative AI</p> <p>Growing. Specialised solutions</p> <p>Specialised in generating new content or design in a specific domain</p> <ul style="list-style-type: none"> • Turbine blade design optimisation • Smart grid topology design • Solar panel layout optimisation ... <p> AutoGrid</p> <p> C3 AI Suite</p> <p> CARBON CURE</p> | <p>General & Generative AI</p> <p>New. But GPT surprised everyone</p> <p>Able to learn, understand, and generate new content across a wide range of tasks and domains</p> <ul style="list-style-type: none"> • AI-assisted decision-making • AI-generated energy system design • AI-generated business model ... <p> OpenAI</p> <p>ChatGPT</p> |  |  |


It will transform energy operation, innovation & decision making




From a supporting role in the short term to an integrated AGI in the long term



 **Supporting role**




 **Company-specific chatAI**

 **Integrated value-chain AGI**

| | Now (2023-2025) | Midterm (2026-2030) | Long-term (2030+) |
|---|---|--|--|
| ChatGPT-like AI deployment | <p>For now, it can play a supporting role to improve operational efficiency, decision-making and collaboration through external applications such as plug-ins and generic software</p> <ul style="list-style-type: none"> • API and Plug-in • SaaS • Generic APPs (Office, Teams etc.) | <p>Midterm, general AI can drive the integration of enterprise data & AI APPs, creating a unified AI platform to enhance interoperability and seamless integration of existing tools</p> <ul style="list-style-type: none"> • Enterprise-specific chatbot • Multimodal data integration • AI tool integration | <p>Long term, AGI can drive integration across energy systems, support complex problem-solving, enable autonomous control, and foster new business models and services</p> <ul style="list-style-type: none"> • Strong AI (AGI) • Value chain system integration • Automated decision maker |
| Operation  | <ol style="list-style-type: none"> 1 Communication & customer service 2 Data preparation and processing | <ol style="list-style-type: none"> 1 Enhanced optimisation 2 Integrated predictive maintenance 3 Environmental & safety management | <ol style="list-style-type: none"> 1 Simultaneous cross domain optimisat. 2 Tailor made energy solutions 3 Tackle new & challenging problems |
| Decision making  | <ol style="list-style-type: none"> 1 Gather information 2 Provide market analysis 3 Suggest initial solutions | <ol style="list-style-type: none"> 1 Integrated enterprise data system 2 Multimodal data synthesis 3 Detailed solution proposals | <ol style="list-style-type: none"> 1 Fully informed decision making 2 Automated decision making 3 Highlight key decision areas |
| Innovation  | <ol style="list-style-type: none"> 1 Generate initial ideas 2 Enhance R&D collaboration | <ol style="list-style-type: none"> 1 Identify emerging technologies & trends 2 Generate technical designs 3 Generate new ideas & approaches | <ol style="list-style-type: none"> 1 Comprehensive AI-driven R&D 2 Novel business models |

Operation: improve collaboration, automation & optimisation

At first, general AI can be integrated into existing energy management & monitoring systems

| | Commu. & Collaboration | Automation | Energy system |
|--------------|---|--|--|
| Progression |  <p>Enhance communication & collaboration</p> |  <p>Improve automation</p> |  <p>Optimise energy system</p> |
| Applications | <p>1 Communication & customer service</p> <p>ChatGPT can create human-like text to help automate customer service and internal communications. It can be used to automate responses to routine enquiries from customers, partners or employees, saving time and effort for customer service and internal communication teams. It's strength in language communication and its ability to understand and reason can take the automation and quality of customer service to a whole new level.</p> <p>2 Data analysis</p> <p>It can gather up-to-date information, research new developments in the energy sector and provide data-driven insights.</p> | <p>1 Advanced optimisation</p> <p>With further development and integration of domain-specific knowledge, ChatGPT can eventually contribute to more specialised tasks such as optimisation algorithms.</p> <p>2 Integrated predictive maintenance</p> <p>As ChatGPT gains the ability to analyse visual and video data, it could process and monitor satellite imagery, photographs and live feeds from production facilities to identify potential problems or inefficiencies in real time. It could also review recorded footage to learn from past events and improve its predictive capabilities.</p> <p>3 Environment & safety management</p> <p>By analysing sensor data, satellite imagery and other relevant information, ChatGPT could help energy companies minimise environmental impact and ensure the safety of operations.</p> | <p>1 Simultaneous cross domain optimi.</p> <p>AGI can optimise the whole energy system. For example, it can be used to simultaneously optimise energy production, distribution and consumption across different energy sources. This could lead to more efficient, resilient and adaptive energy systems.</p> <p>2 Tailored energy solutions</p> <p>AGI could enable tailored energy solutions for individual businesses or even consumers, optimising energy use and costs in real time based on user preferences and behaviour.</p> <p>3 Tackling new & challenging problems</p> <p>General AI has the potential to tackle complex, multi-objective optimisation problems in the energy industry, such as coordinating distributed energy resources, optimising grid management and balancing supply and demand in real time.</p> |

Decision making: an integrated, customised enterprise chatbot

A customised chatbot integrates all internal and real-time external data is within reach

In the year 2027, Dr Sarah Patel, CEO of SalIBP, an international energy company, arrives at her office to start another busy day. As she enters her office, she activates the ChatSBP interface via a secure biometric login.

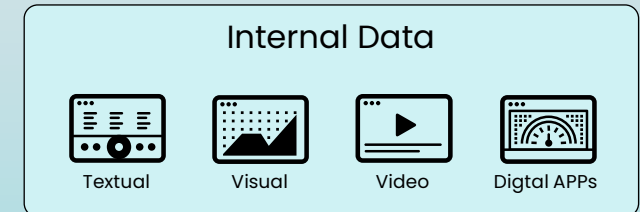
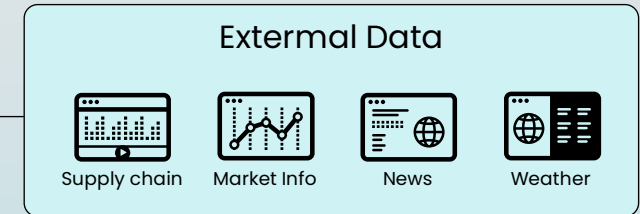
"Good morning, ChatSBP," Sarah says to the AGI assistant. "Please walk me through the highlights of our global energy portfolio."

ChatSalIBP: "Here is a summary of our global energy portfolio: Oil and gas production is at 98% efficiency. Our CCS projects successfully captured 1 million tonnes of CO₂ last month. Our offshore wind farm has reached a record 65% capacity factor... "

Sarah then asks specific questions: "What are the current market trends and how can we use these insights to optimise our operations? "

ChatSalIBP quickly analyses the data and presents its findings: "Recent market trends indicate a growing demand for clean and renewable energy sources. Here are some recommendations:

- Accelerate investment in renewables with a focus on floating wind.
- Expand R&D efforts in SAF with the aim of early market entry.
- Increase collaboration with start-ups such as Aroka and Bosta to explore commercialised direct air CCS solutions... "






ChatSalIBP



Dr. Sarah Patel

Innovation: generate ideas, design and business model

Chat-GPT like AI can accelerate R&D and innovation with its growing generative capabilities

| | Idea generation | Design | New business model |
|--------------|--|--|--|
| Progression |  <p>Idea generation</p> |  <p>Engineering design</p> |  <p>Business model generation</p> |
| Applications | <p>1 Generate initial ideas</p> <p>ChatGPT can gather up-to-date information, research new developments in the energy sector, and offer data-driven insights.</p> <p>In addition, ChatGPT's vast knowledge base and generative capabilities can be used to generate initial ideas at the brainstorming and solution generation stages.</p> <p>2 Improve R&D collaboration</p> <p>AI can enhance communication and collaboration within an organisation, improving productivity and fostering a culture of innovation.</p> <p>ChatGPT can produce human-like text, which can be useful for simulating conversations with experts, generating new ideas, or providing insight into regulations and policies.</p> | <p>1 Identify emerging tech. & trends</p> <p>ChatGPT could support R&D efforts in the energy industry by analysing the latest scientific literature, identifying emerging technologies and trends, and even generating new ideas and approaches. This could help energy companies stay at the forefront of innovation and maintain a competitive edge.</p> <p>2 Generate engineering designs</p> <p>Generative AI can help design more efficient energy systems, such as wind turbines or solar panels, by creating novel designs and testing them in virtual environments.</p> <p>3 Generate new ideas & approaches</p> <p>Generate new ideas and approaches Generative AI can suggest new approaches to challenging energy problems by generating potential solutions based on the patterns it identifies in training data.</p> | <p>1 Comprehensive AI-driven R&D</p> <p>AGI can accelerate the development and deployment of novel energy technologies through AI-driven R&D, driving the transition to a more sustainable and resilient global energy system.</p> <p>2 Novel business models</p> <p>As AI technologies mature, new business models and services could emerge in the energy sector, leveraging the capabilities of general AI to provide innovative solutions and optimise resource allocation.</p> <p>AI can identify new growth opportunities, enabling the development of new revenue streams and business model transformation for energy companies.</p> |

Recommendation for companies in the energy industry

Understand the strategic importance of ChatGPT-like AI and develop a sound strategy

ChatGPT-like AI systems hold great promise for the energy industry, offering immediate benefits and long-term value. To effectively harness the potential of AI, energy companies should focus on strategic implementation and continuous adaptation. Here are seven key areas to consider:

❶ Prioritise immediate applications

Focus on ChatGPT-like AI applications that offer immediate benefits and are easier to integrate.

❷ Collaborate

Partner with technology providers, research institutions, and other energy companies to stay at the forefront of AI innovation and leverage cutting-edge solutions.

❸ Adapt continuously

Stay informed about AI and energy advancements to identify new opportunities and outpace competitors. Continuous adaptation is essential for success in this rapidly evolving landscape.

❹ Invest in digital infrastructure and data quality

High quality data and robust digital infrastructure are critical to the success of AI. Provide resources to support the development and deployment of AI.

❺ Reskill and upskill the workforce

As AI transforms the energy industry, invest in talent development and foster a culture of innovation and collaboration. Encourage employees to adapt and learn alongside the technology.

❻ Prepare for regulatory changes

Stay compliant with AI and data privacy regulations. Be ready to adapt to new regulatory guidelines as they emerge.

❼ Prioritise data security and privacy

Ensure compliance with regulatory standards and protect sensitive information by implementing robust data protection measures, especially when integrating multiple AI models and tools.



3 Appendix

About the author

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Victor Liu is an energy consultant with more than 15 years of global experience. He was previously Director of Consulting at Wood Mackenzie and Head of Transaction Services at Infield Systems in London.

Victor has extensive knowledge and experience in renewable energy and digitalisation. At Hemado, he has advised international energy companies on renewable energy & digitalisation strategy formulation, market expansion plans and analysis of investment opportunities in cutting-edge green technologies such as hydrogen, CCUS, floating wind, microgrid and VPP.

Victor has led several due diligence and support projects for M&A transactions on behalf of top-tier financial institutions, including KKR, Goldman Sachs, Carlyle, Basalt and Alchemy. He has also led strategic or commercial advisory projects for a number of industrial companies including General Dynamics, CIMC, PetroChina, Nippon Steel, Acteon, Hydrasun and Centurion.

Victor is a regular speaker at global energy conferences and has published his findings in academic and industry journals. He is a member of the editorial board of the London/Chicago Commodity Insights Digest (CID). His academic qualifications include a PhD in Financial Engineering from Cass Business School in London, UK, and a first class BA and MA in Economics from the University of Bath, UK.

Hemado

- Hemado is a London-based new energy consultancy, providing market insights, consulting and transaction support.
- Focusing on frontier clean energy topics such as energy transition, offshore engineering, offshore wind, green hydrogen, CCUS, floating solar, wave energy and energy storage.
- Hemado has built a global proprietary energy database, covering energy market fundamentals, projects, costs and supply chain activities.

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GESCA

- GESCA is a global energy supply-chain alliance, facilitating global talks and providing industry information and insights.
- GESCA has over 2,000 members covering over 20 Industries across energy sectors, including oil & gas, solar, wind, hydrogen, smart grids, chemicals, energy storage, electric vehicles.
- Facilitating global talks and interviews addressing key industry topics and challenges facing governments, policy makers and energy leaders.
- Providing up-to-date industry information, insights, research services for its members across the energy value chain, supporting their transition to a sustainable business landscape.

www.gesc-alliance.org

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