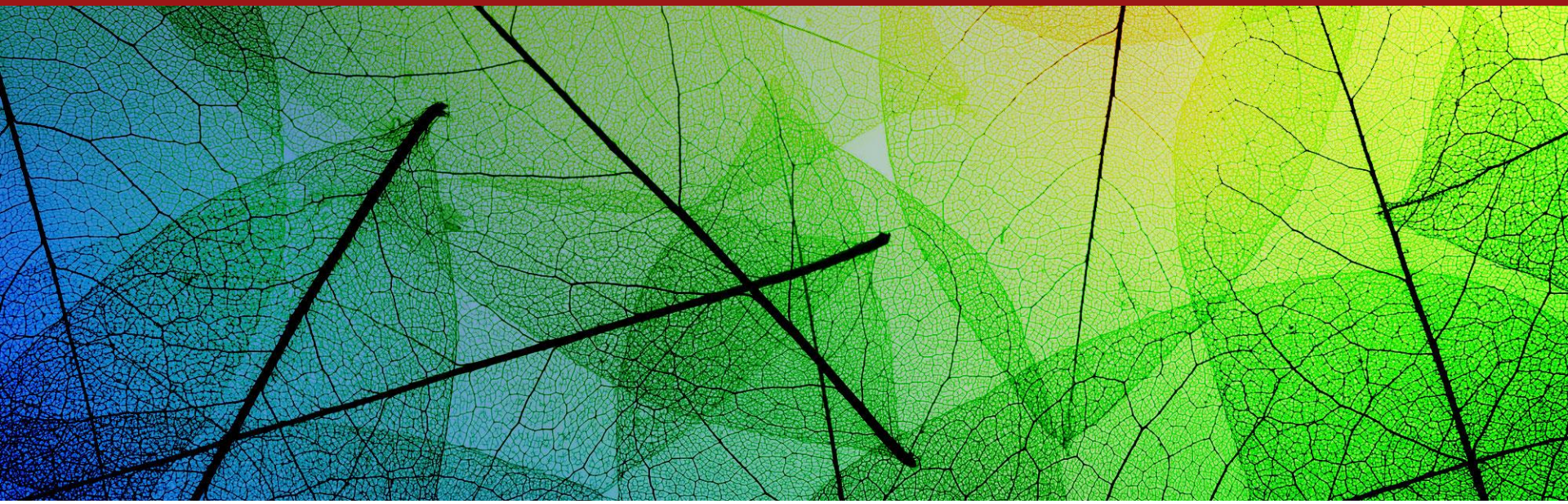


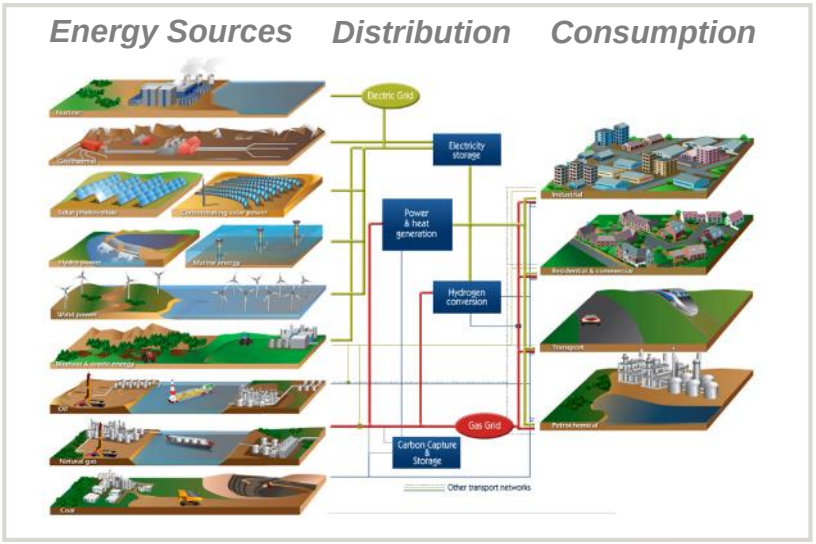
A.T. Kearney Energy Transition Institute

Media Presentation

Energy Transition is generating major business transformations across the energy sector enabled by new technologies

Objectives

- Climate Change
- Energy Security
- Energy Cost
- Social Acceptance



Levers

- Energy efficiency
- CCS and Use
- Fuel switching
- Renewable energies
- Nuclear

Megatrends

Decarbonization	Decentralization	Electrification	Digitalization	Integration	Customerization
Block-chain	Vehicle-to-Grid	Unconventional Gas	Power-to-Gas		Electric Vehicles
Smart Grids	H2	Energy Storage	Smart Home	Digital Prosumer	…

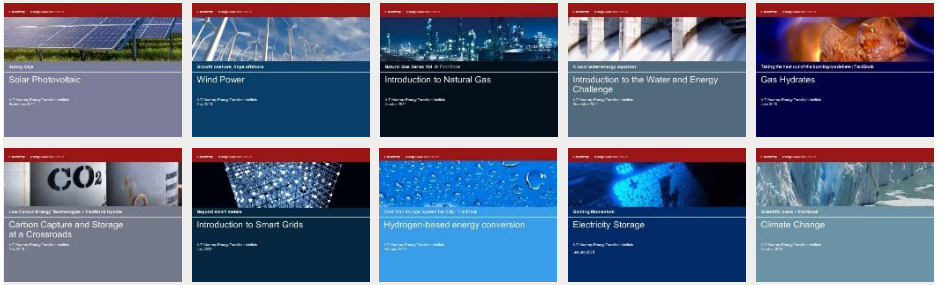
Sources: A.T. Kearney Energy Transition Institute

The Energy Transition Institute studies global trends in energy transition and their strategic implications for businesses and governments

A.T. Kearney Energy Transition Institute

- Created in 2011 as a non-profit and independent energy research organization, governed by its own Board
- Focus on independent energy transition research with the objective to mitigate climate change, provide safe, efficient and affordable energy while ensuring social acceptance and meeting end user demands
- Communicates its research findings to a large audience and provides insights regarding energy transition:
  - Mega trends (decarbonization, decentralization, electrification, and digitalization…)
  - Opportunities, challenges and strategic implications of energy transition for industries and governments
  - Technology deployment & RD&D, economics and key players
- Collaborates with leading academic institutions, energy stakeholders and companies
- Combines technological insights and economical perspectives with foresight and business expertise of A.T. Kearney and the Global Business Policy Council
- Open to external collaboration and joint research activities

Research and Insights



Bloomberg New Energy Finance

Published "Bringing Carbon Capture and Storage to Market" together with Bloomberg New Energy Finance

iea – International Energy Agency

Supported the iea with technology roadmaps around Energy Storage; Hydrogen and Smart Grids

Knowledge partnerships

GPEX2018 GLOBAL POWER & ENERGY EXHIBITION

SPE International Society of Petroleum Engineers

Global conferences

SSV CONFERENCE2018

20th WORLD HYDROGEN ENERGY CONFERENCE 2014 whec2014.com

WGC PARIS2015 WORLD GAS CONFERENCE

The Energy Transition Institute is governed by its own Board with access to global experts

Composition of the Energy Transition Institute (ETI) Board

Chairman			*Secretary / Treasurer*				*MD*
							
Richard Forrest	Erik Peterson	Kurt Oswald	Stefan Berruti	Claude Mandil	Dr. Adnan Shihab-Eldin	Antoine Rostand	Romain Debarre
• Chairman of the ETI Board, • A.T. Kearney Energy Practice Global Leader • A.T. Kearney Global Board Member	• Macro/Geopolitical energy expertise and connects the institute with A.T. Kearney Global Business Policy Council (GBPC)	• A.T. Kearney Energy Practice Partner -deep expertise on Energy Transition	• Legal counsel, • Secretary and Treasurer of ETI	• Former Executive Director of the International Energy Agency (IEA) and former Chairman and CEO of IFPEN	• Former Acting Secretary General and Director of Research at OPEC, Director General of the Kuwait Foundation for the Advancement of Sciences (KFAS)	• CEO and Founder of Kayrros, former CEO and Founder of Schlumberger Business Consulting	• Managing Director of the ETI

Available FactBooks

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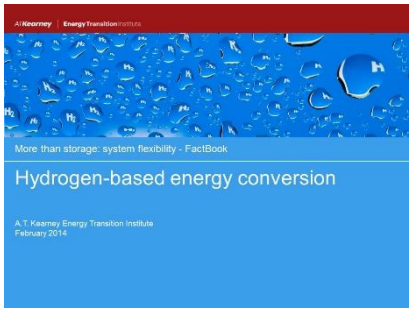
Bringing Carbon Capture and Storage to Market

This FactBook reflects the latest changes in the CCS landscape by 2016. It summarizes the main Research & Development priorities in CCS, analyzes the economics of the technology and presents the status and future of large-scale integrated projects. Carbon Capture and Storage is one of the most underrated climate-change mitigation options available today. It is widely regarded as technically capable of abating vast amounts of carbon dioxide from the atmosphere at competitive costs. Yet, unless associated with a beneficial reuse of CO2, CCS has net costs for the project owner to be borne solely for the purpose of reducing climate risk. Therefore, the CCS industry is at risk of never developing beyond the few subsidized projects, unless proper prices are associated with carbon emissions.



Hydrogen-Based Energy Conversion

The FactBook presents the technological progress and economic reality of the role of hydrogen in the energy space and analyzes hydrogen-based solutions developed to overcome the intermittency challenge of renewable energies. The value of hydrogen-based energy conversion solutions lies predominantly in their ability to convert renewable power into chemical energy carriers. The main challenge for hydrogen conversion, however, lies not in its technology but in its economics and may suffer from the high number of stakeholders involved. Three formats have been published: A long, horizontal FactBook (300 slides) and two shorter summary: a vertical abstract (17 pages) and an executive presentation (60 slides)

Wind Power

This FactBook summarizes the status of the wind industry and its prospects, lists the main technological hurdles and principal areas for research and development, and analyzes the economics of this technology. Wind power is by far the largest renewable energy after hydro power. The development of wind power has accelerated over the past decade and growth is expected to continue, increasingly driven by Asia, but also by emerging markets in Latin America or Africa. It is important to distinguish onshore wind power, a mature, proved technology, from offshore concepts, which still need to overcome the deployment challenge and to demonstrate their economic viability. In the longer term, airborne wind systems may change the game by harvesting higher wind speeds, while lowering investment costs. But airborne wind remains at an early stage of development.

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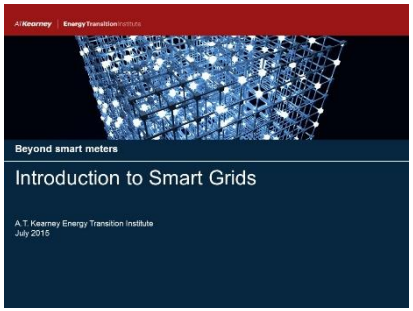
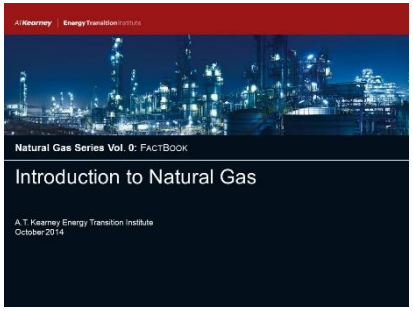


Introduction to Smart Grid

The Smart Grids FactBook examines the innovations that comprise what is collectively known as Smart Grid technologies. The Smart Grids FactBook gives a comprehensive assessment of the transition to a modern, digital, and optimized electric grid. Numerous innovations can already contribute to the modernization of electricity networks. They aim to: enable the use of all generation and storage options; optimize energy efficiency and asset utilization; improve power quality for end-user devices; self-heal; resist physical and cyber attacks; and enable new business solutions in a more open-access electricity market. But social acceptance, cybersecurity, regulation, and international collaboration on standardization and best practices are vital to successful deployment. Electrons are the fastest-growing energy carrier and a pivotal element of the transformation of the energy system. Economies will become increasingly dependent on electricity, as renewable energy expands and environmental concerns intensify. As a result, electricity networks are being rapidly modernized through the introduction of smart-grid technologies.



Introduction to Natural Gas

This FactBook assesses the reasons behind natural gas's growing importance within the global energy mix and challenges associated with gas use, as well as the current status of and likely developments in natural-gas technologies. Natural gas is used in power generation, for industrial applications, buildings, and transportation. Though historically it has been extracted through conventional means, unconventional extraction processes play a part in regions such as North America. Having long been overlooked as an energy source, natural gas has become a crucial part of the energy mix and will remain so due to its sizeable and accessible resources, low carbon foot print, and versatility. Natural gas accounts for more than 20% of the global primary energy mix. Even though complex infrastructure is needed to get natural gas to end users, global trade is increasing and the share of energy from natural gas is expected to rise in the future, especially for power generation, where it can be used to replace coal power and to fill power gaps created by intermittent renewable energy sources.

Gas Hydrates

This FactBook seeks to provide stakeholders with a balanced, unbiased assessment of gas hydrate to determine the potential and future of this resource. It presents the key concepts; the status of exploration and production technologies; the status of research, development and demonstration (R,D&D); and the environmental and safety challenges associated with the potential exploitation of gas-hydrate resources. Gas hydrates are a new frontier in unconventional gas developments. There are vast quantities of hydrates on the planet, but only part of them are concentrated enough to be viable in the future. Contrary to common beliefs, the technology to find and recover gas hydrates is reasonably mature, but the understanding of the challenges to effectively produce them are still young. The viability and better understanding of gas hydrates development will depend upon upcoming extended production campaigns, with Asia at the forefront.

Available FactBooks

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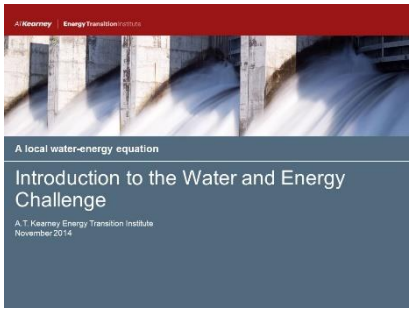
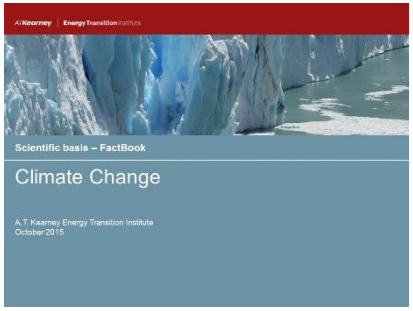


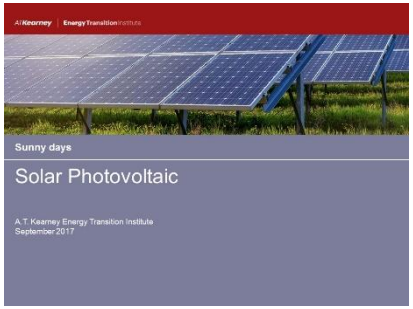
Introduction to the Water and Energy Challenge

This FactBook illustrates how Energy & Water are highly interconnected locally and globally and highlights the fact that water shortages are already affecting energy supply in some areas and that location-specific solutions will be required. This publication provides a global picture of the main water resources; an overview of the current and forecasted mismatch between supply and demand, and its likely consequences and a summary of water risks and the multi-dimensional nature of these risks Freshwater demand is forecast to surpass reliable accessible supply by ~40% globally by 2030. Technical solutions exist for increasing supply locally. But the most promising levers rely on improving water- resource management and reducing consumption per capita. Solutions are to be developed locally, taking into account virtual water traded and carefully arbitrating economic development choices, in light of the water-food-energy nexus.



Climate Change

This document seeks to make an objective summary of the status of scientific studies on climate change. The report defines the core scientific concepts at stake, presents evidences and discuss attribution of past and recent climate changes, summarizes latest climate model's projections of human-induced climate change and related consequences, while highlighting key uncertainties and other issues on which there has been some debate.



Solar Photovoltaic

This FactBook seeks to summarize the status of the solar photovoltaic (PV) power industry and paths for development, analyzing the principal technological hurdles, likely areas of focus for Research and Development (R&D) efforts and the economics of PV systems.

Solar Photovoltaic (PV) technology harnesses direct solar energy. Solar PV has taken off in the past decade and has experienced rapid and significant annual cost reductions as a result of falling module prices. However, the vast majority of installed PV-systems are connected to the power network, inducing challenges for grid management. Solar has the potential to meet all global primary energy demand. Solar irradiance, the instantaneous amount of power provided by the sun at a given location and time, is of fundamental importance in the use of solar power. It is considered good to excellent between latitudes of 10° and 40°, South and North. Nevertheless, the solar resource is one of the most evenly distributed energy resources available on Earth.

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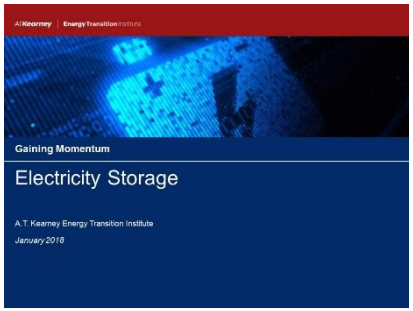

Electricity Storage

This Factbook seeks to capture the current status of and future developments in electricity storage, detail the main technological hurdles and areas for Research and Development, and analyze the economics of a range of technologies. Electricity storage continues to gain momentum globally. Being essential to the development of renewable energies and to the electric vehicles, electricity storage is at the heart of the energy transition and enables many new applications and uses including the overall electrification of energy systems. Relying on several and different technologies, electricity storage is witnessing a very dynamic research activity where many innovations are emerging from the “valley of depth”. By far, hydro storage remains the dominant technology, while some battery technologies still need to demonstrate their economics at various scale of application.

The A.T. Kearney Energy Transition Institute is a nonprofit organization. It provides leading insights on global trends in energy transition, technologies, and strategic implications for private sector businesses and public sector institutions. The Institute is dedicated to combining objective technological insights with economical perspectives to define the consequences and opportunities for decision makers in a rapidly changing energy landscape. The independence of the Institute fosters unbiased primary insights and the ability to co-create new ideas with interested sponsors and relevant stakeholders.

For further information about the A.T. Kearney Energy Transition Institute and possible ways of collaboration, please visit www.energy-transition-institute.com, or contact us at contact@energy-transition-institute.com.