



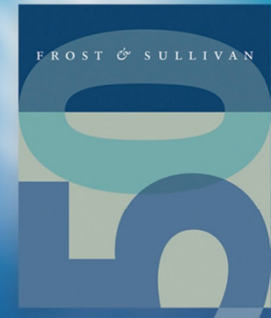
IERE – Technology Foresight 2016

Top 20 Emerging Technologies and
Top 5 Fringe Technologies for IERE

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**Industry Principal, TechVision
Frost & Sullivan**



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IERE Technology Foresight 2016: Project Objectives

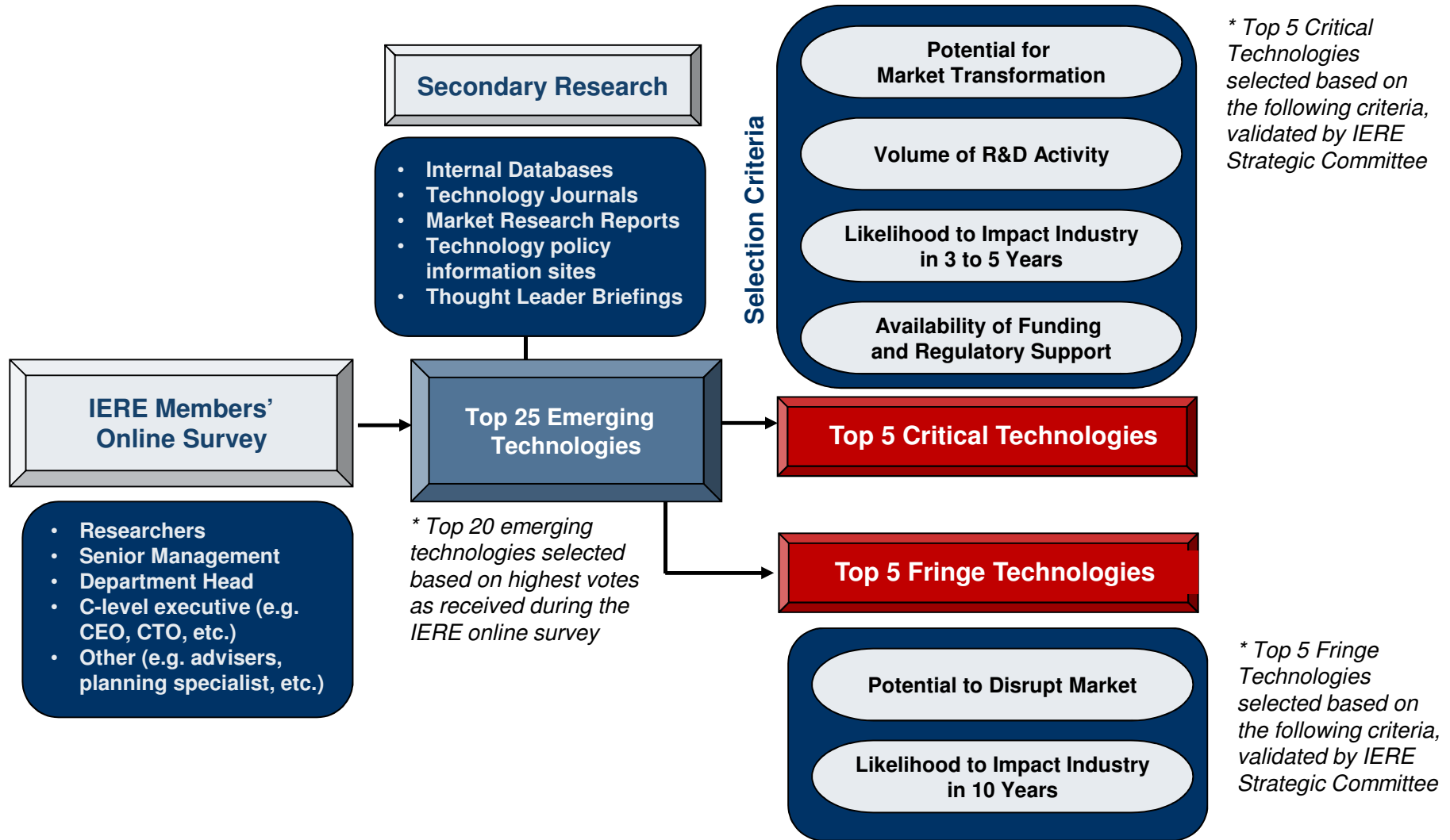
Engagement Objectives

- Identify and review the technologies that IERE members determine as critical for the coming decades and addressing climate change
- Provide background information on the selected technologies (costs, development status, etc.)

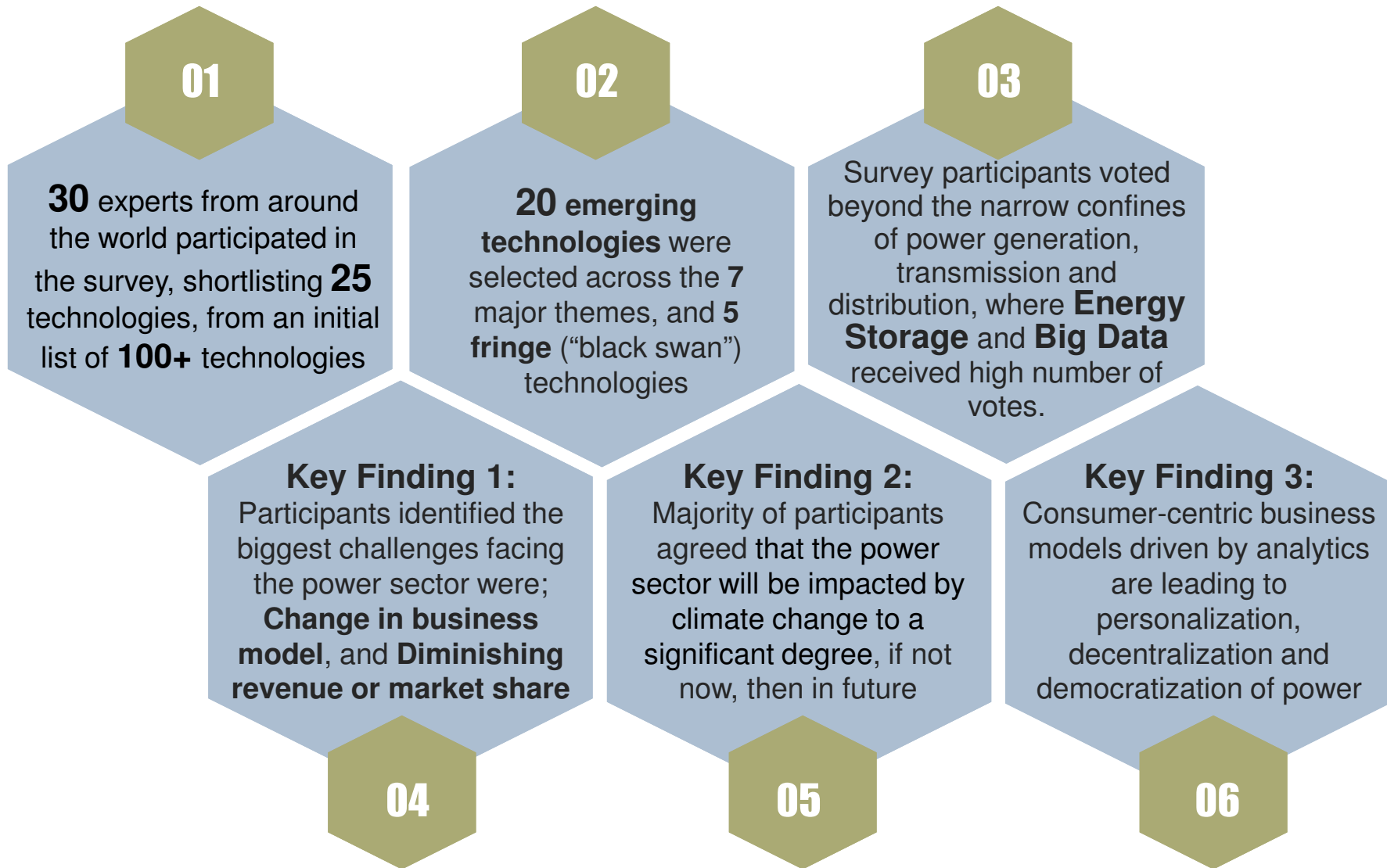
Engagement Outputs

1. IERE Member Survey Result
2. Top 20 Emerging Technologies Review
3. Top 5 Critical Technologies Detailed Review
4. Top 5 Fringe Technologies (Black Swan) Review

Project Methodology



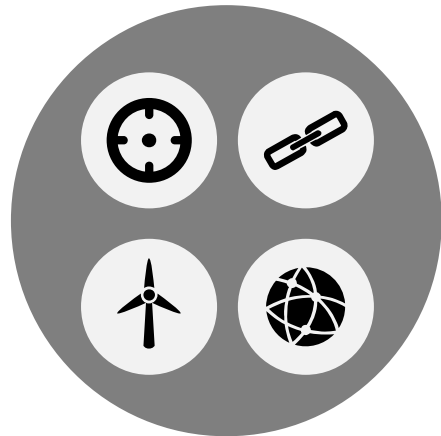
Summary and Key Findings of IERE Survey



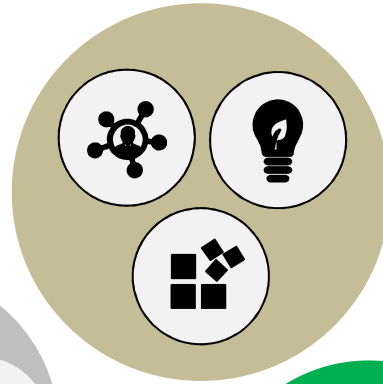


Top 25 Technologies

Summary of Top 20 Emerging Technologies by 7 Themes

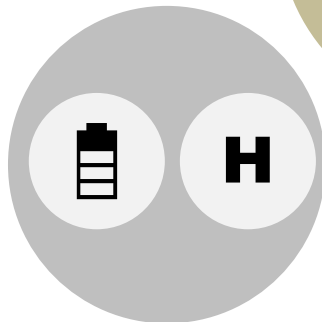


- Hybrid energy
- Offshore Wind
- Nuclear Gen III+
- CCUS



- Smart grid
- Renewable and distributed generation
- Energy storage devices

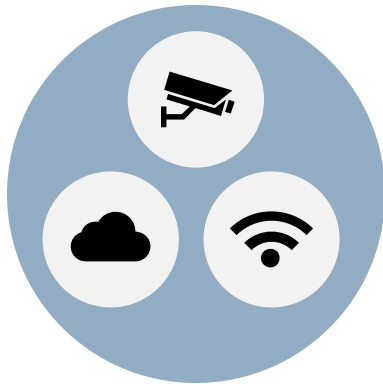
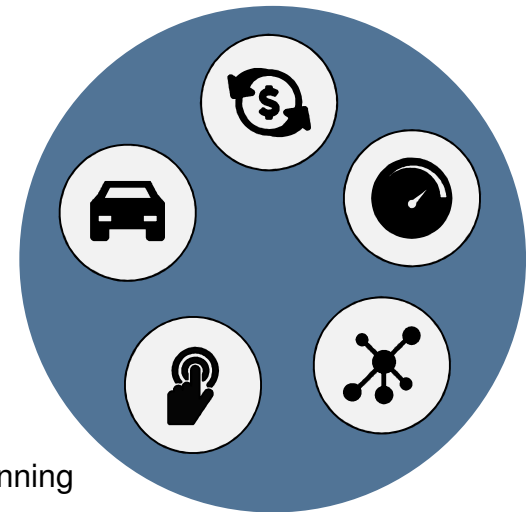
- Prosumer technologies
- Electric, hybrid and fuel cell vehicles
- Internet of Things (IoT)
- Virtual power plant
- Smart X



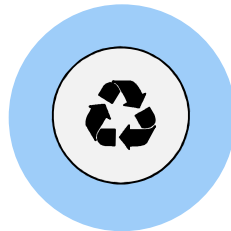
- Lithium-ion battery
- Hydrogen energy storage



- Climate modeling
- Water resources planning



- Wireless sensors
- Big data applications
- Grid and home cybersecurity



- Water recovery and reuse

Alternative sources of power generation

Energy storage

Climate change

Allied technologies






Power transmission & distribution

End use and energy efficiency






Water resources

Top 5 Critical Technologies*






(*refers to emerging technologies that are commercialized)

	TECHNOLOGY	DESCRIPTION	TRANSFORMATION RATING
	Prosumer Technologies	Technologies that enable end users to become both consumers and producers of electricity.	5
	Energy Storage Devices	A system that stores electrical energy in the form of chemical, mechanical or electrical energy.	5
	Big Data Applications	A set of data management tools for effective analysis of big data sets so as to derive intelligence on business.	5
	Renewable & Distributed Generation	Power generated using small-scale systems sited close to the point of use, usually renewable or co-generation technologies.	5
	Climate Modelling	A mathematical representation of climate to predict future climate behaviour.	5






Top 25 Emerging Technologies *(excluding Top 5 Critical and Top 5 Fringe)*

	TECHNOLOGY	DESCRIPTION	TRANSFORMATION RATING
	Electric, Hybrid & Fuel Cell Vehicles	A vehicle that utilizes electricity generated either from a battery or fuel cell to drive a motor to propel it forward.	4.5
	Smart Grid	An intelligent grid that can be monitored and controlled by combining automation, data processing and communication technologies.	4.5
	Lithium-Ion Battery	A type of battery that uses lithium as an electron source; tremendously popular as a power source for many types of devices.	4.5
	Internet of Things (IoT)	A network of technologies that facilitate the linking of sensors, controllers, sensors, and persons over the Internet.	4.5
	Wireless Sensors	Spatially distributed autonomous sensors, mostly battery operated.	4.5

Top 25 Emerging Technologies *(excluding Top 5 Critical and Top 5 Fringe)*






	TECHNOLOGY	DESCRIPTION	TRANSFORMATION RATING
	Water Recovery and Reuse	Collection and treatment of wastewater to requisite levels, for use in the same unit/ plant or in other applications.	4
	Water Resource Planning	Holistic approach to the management of water systems including supply and demand, water quality, environmental protection, etc.	4
	Offshore Wind Energy	Energy generated by wind turbines installed at sea.	4
	Grid and Home Cybersecurity	Systems that ensure timely access to information, while guarding the data against improper modification and loss.	4
	Smart X	Smart and connected devices such as meters, appliances, homes, buildings, and cities.	4

Top 25 Emerging Technologies *(excluding Top 5 Critical and Top 5 Fringe)*

	TECHNOLOGY	DESCRIPTION	TRANSFORMATION RATING
	Carbon Capture, Utilization & Storage (CCUS)	The capture of anthropogenic carbon emissions, where the carbon is stored or converted later into other valuable products.	4
	Virtual Power Plant (VPP)	A group of prosumers interacting with another group of prosumers for selling and buying of electricity.	3
	Hydrogen Energy Storage	Energy storage system that stores surplus electricity in the form of hydrogen gas.	3
	Hybrid Energy Systems	Combination of more than one energy resource, which can be renewable or fossil fuel-based, to balance energy generation.	3
	Nuclear Power Gen III+	Has better safety measures than Generation II reactors, and requires minimal active control and manual intervention	3

Top 5 Fringe Technologies

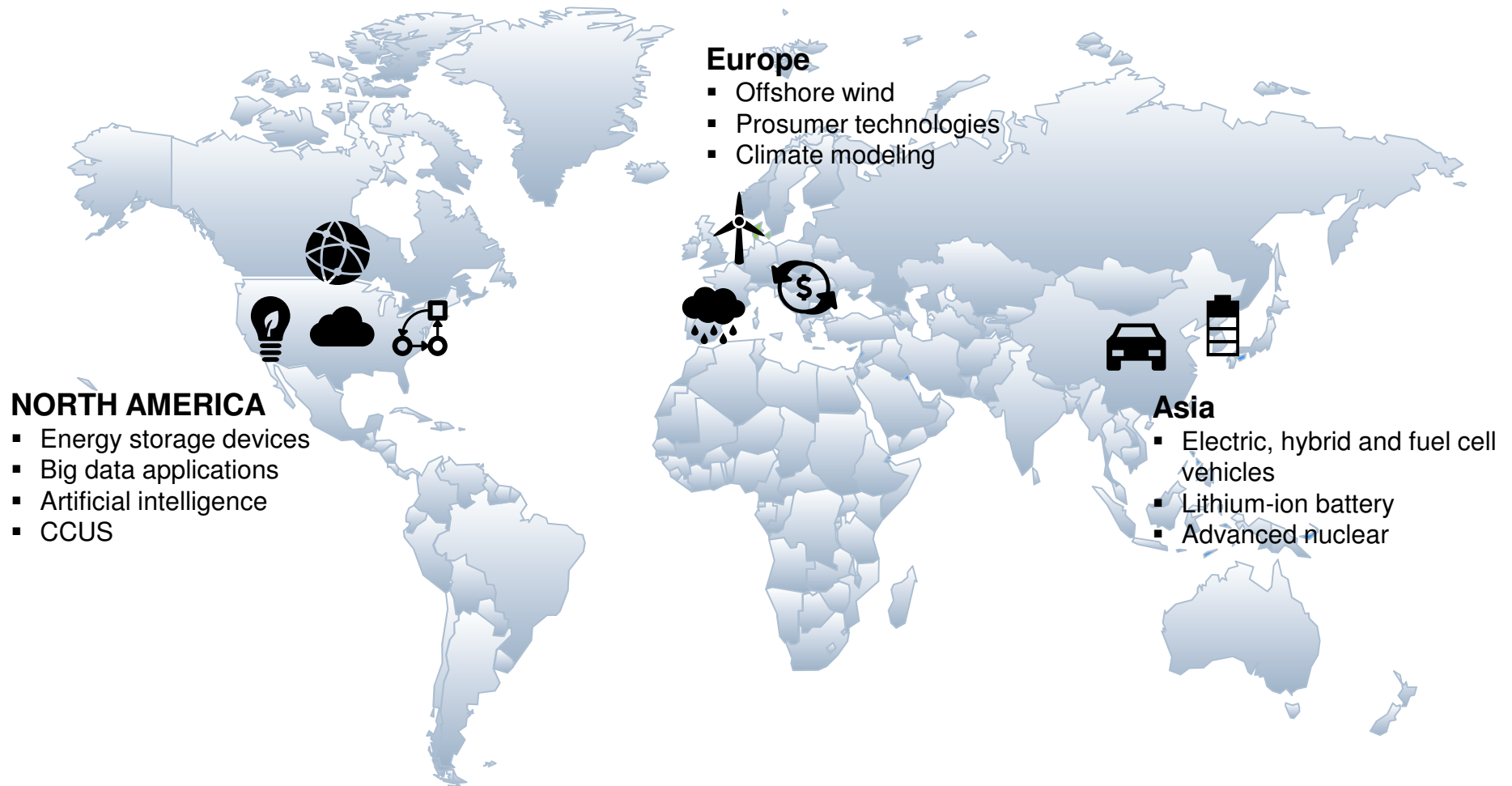
(*Fringe technologies are ones considered to have remote possibilities, but could potentially disrupt the energy industry)

	TECHNOLOGY	DESCRIPTION	TRANSFORMATION RATING
	Artificial Intelligence	A system that has human-like cognitive capabilities such as learning, reasoning, problem solving, and self-correction.	5
	DC Grid	Grid that does not require DC/AC inverters for intermediate power conversion before the generated DC power is consumed	3
	Artificial Photo-synthesis	Process that mimics natural photosynthesis, where fuels and chemicals are produced using carbon dioxide, water, and sunlight.	2
	Advanced PV	Advanced PV refers to low-cost, lightweight, and flexible, mainly or high efficiency silicon-based solar cells.	2
	Advanced Nuclear	Advanced nuclear technology refers to Gen IV reactors, small modular reactors and nuclear fusion.	2

Technology Status (for Top 5 Critical and Top 5 Fringe)



R&D Hot Spots for Top 25 Technologies



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