

# Top 10 Energy Innovators in 100 Energy Priorities

**A unique report mapping industrial and academic players  
in global competition**



Sample

## About Questel Consulting

Questel provides a comprehensive suite of web-based services for productivity and collaboration dedicated to intellectual property. Covering the entire innovation cycle, from idea to product, Questel's offerings include:

- Competitive intelligence and technological landscape,
- Ideation management and innovation capture,
- Technology scouting and licensing-in,
- Invention management and prior-art searching,
- Portfolio management and pruning,
- Licensing-out and monetization.

Questel Consulting team is the result of the fusion of Avenium in France (created in 2002 as a spin-off of the CEA) and the PatentPeople in the US (created in 2008). Questel Consulting team is specialized in management and strategy for intellectual property and technology.

### OUR CLIENTS & FIELDS OF EXPERTISE

Our customers are international groups, SME and start-ups as well as academic research centers.

Our diversified fields of expertise cover energy, micro-electronics, transportation, materials, chemistry, pharmaceuticals, life sciences, etc.

### OUR SERVICES

Assist our clients in building their industrial property strategy and enabling them to:

- sustain competitive advantage
- speed up R&D
- mitigate risks
- maximize profit

Assist our clients in portfolio valorisation and technology transfer for their patented inventions.

## KIC InnoEnergy

KIC InnoEnergy SE is the European company dedicated to promoting innovation, entrepreneurship and education in the sustainable energy field by bringing together academics, businesses and research institutes.

Our goal is to make a positive impact on sustainable energy in Europe. We do this by creating future game changers with a different mind-set, and bringing innovative products, services and successful companies to life.

KIC InnoEnergy is one of the first Knowledge and Innovation Communities (KICs) fostered by the European Institute of Innovation and Technology (EIT). We are a commercial company with 27 shareholders that include top ranking industries, research centres and universities, all of which are key players in the energy field. More than 150 additional partners contribute to our activities to form a first class and dynamic network that is always open to new entrants and furthers our pursuit of excellence. Although we are profit-oriented, we have a "not for dividend" financial strategy, reinvesting any profits we generate back into our activities.

With our headquarters in the Netherlands, we develop our activities across a network of offices located in Belgium, France, Germany, the Netherlands, Spain, Portugal, Poland and Sweden.

KIC InnoEnergy & Questel Consulting

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# Glossary

## Players acronyms

**AAU.** University of Aalborg  
**AIST.** National Institute of Advanced Industrial Science and Technology  
**BP.** British Petroleum  
**CAS.** Chinese Academy of Sciences  
**CEA.** Commissariat à l’Energie Atomique et aux énergies alternatives  
**CEPRI.** China Electric Power Research Institute  
**CERTAM.** Centre d’Etude et de Recherche Technologique en Aérothermique et Moteurs  
**CIEMAT.** Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas  
**CIRAD.** Centre de coopération International en Recherche Agronomique pour le Développement  
**CNRS.** Centre National de la Recherche Scientifique  
**CRIEPI.** Central Research Institute of Electric Power Industry  
**CSIC.** Consejo Superior de Investigaciones Científicas  
**CSIR.** Council of Scientific Industrial Research  
**DLR.** Deutsches Zentrum für Luft- und Raumfahrt  
**DOE.** Department Of Energy  
**DTU.** Denmark Technology University  
**EDF.** Électricité de France  
**EPFL.** École Polytechnique Fédérale de Lausanne  
**EPRI.** Electric Power Research Institute  
**ETH.** Eidgenössische Technische Hochschule  
**ETRI.** Electronics and Telecommunications Research Institute  
**GE.** General Electric  
**IFP.** Institut Français du Pétrole  
**IMEC.** Interuniversity Microelectronics Centre  
**IREC.** Catalonia Institute for Energy Research  
**ITRI.** Industrial Technology Research Institute  
**JOGMEC.** Japan Oil, Gas and Metals National Corporation  
**KEPCO.** Korea Electric Power Corporation  
**KIER.** Korea Institute of Energy Research  
**KIST.** Korea Institute of Science and Technology  
**KTH.** Kungliga Tekniska högskolan  
**KU Leuven.** Katholieke Universiteit Leuven  
**MHI.** Mitsubishi Heavy Industries  
**MIT.** Massachusetts Institute of Technology  
**NIMS.** National Institute for Materials Science  
**NREL.** National Renewable Energy Laboratory  
**OWET.** Oregon Wave Energy Trust  
**TEPCO.** Tokyo Electric Power Company  
**TNO.** Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek  
**UPC.** Universitat Politècnica de Catalunya  
**UPM.** Universidad Politécnica de Madrid  
**ZAE.** Zentrum für Angewandte Energieforschung

## Economic & business acronyms

**CAGR.** Compound Annual Growth Rate  
**IP.** Intellectual Property  
**JV.** Joint Venture  
**R&D.** Research and Development  
**RoW.** Rest of the World  
**SME.** Small and Medium Enterprises

## Technical acronyms

**BMS.** Battery Management System  
**CAES.** Compressed air energy storage  
**CCS.** Carbon Capture and Storage  
**CdTe.** Cadmium Telluride  
**CHP.** Combined Heat and Power  
**CIGS.** Copper indium gallium selenide  
**CIS .** Copper Indium Selenide  
**CO<sub>2</sub>.** Carbon Dioxide  
**CSP.** Concentrating Solar Power  
**CZTS.** Copper zinc tin sulfide  
**DC.** Direct Current  
**DRM.** Dry Reforming of Methane  
**EMS.** Energy Management Solution  
**ESCo.** Energy Service Company  
**FACTS.** Flexible AC Transmission System  
**GaN.** Gallium Nitride  
**H<sub>2</sub>.** Dihydrogen  
**Hg.** Mercury  
**HVAC.** Heating, Ventilating, and Air Conditioning  
**HVDC.** High Voltage Direct Current  
**ICT.** Information and Communication Technologies  
**IR.** InfraRed  
**KCl.** Potassium Chloride  
**Li.** Lithium  
**NaS.** Sodium Sulfur  
**NiMH.** Nickel Metal hydride  
**Nox.** Nitrogen oxide  
**O&M.** Operation and Maintenance  
**OCAS.** Obstacle Collision Avoidance System  
**PC.** Polycarbonate  
**PCM.** Phase Change Material  
**PEM.** Proton Exchange Membrane  
**PV.** Photovoltaic  
**ROV.** Remotely Operated Vehicles  
**SBM.** Single Buoy Mooring  
**SiC.** Silicon Carbide  
**Sox.** Sulphur oxide  
**T&D.** Transmission and Distribution  
**TCO.** Transparent Conductive Oxide  
**TFPV.** Thin Film Photovoltaic  
**UCG.** Underground Coal Gasification  
**UHV.** Ultra High Voltage  
**VSC.** Voltage Source Convertors  
**VSD.** Variable Speed Drive

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# Top 10 Energy Innovators in 100 Energy Priorities

Dear Reader,

Do you want to identify the right partners in Energy and screen the global Top 10 industrial players, qualified by their capacity to bring innovation to the market place? Are you interested in discovering the Top 10 industrial innovators and the Top 10 academic experts across 100 energy technology priorities? Would you also like to view the annual growth rate and dynamic trends since 2000 of patent filing and publications by industrial and academic players?

Whether you are in industry or an academic leader, local, European or international decision maker, this report is made to answer those questions, highlighting the worldwide dynamics of competition in innovation, to help you identify potential game changers in energy. The *Top 10 Energy Innovators in 100 Energy Priorities* report is the first led by KIC InnoEnergy to map and rank existing global industrial and academic innovators – using quantitative and qualitative Key Performance Indicators – against 100 energy priorities, included in KIC InnoEnergy's Strategy and Roadmaps 2014-2019. This report covers 8 thematic fields: Wind Energy, Ocean Energy, Solar Photovoltaic System, Solar Thermal Electricity, Smart Buildings and Cities, Smart Grids and Electric Storage, Renewable Energy Convergence, Clean Coal and Gas Technologies.

We are pleased to co-publish this report together with *Questel Consulting Europe* who carried-out this extensive study: integrating Market, Technological and Intellectual Property expertise; combining methodology, to establish a scoring system to rank players according to both quantitative and qualitative KPI, to create relevant patent search queries, to conduct worldwide survey questionnaire and run desk research; and mixing sources, using professional data bases, public information and survey results.

KIC InnoEnergy is a unique experience in Europe, a smaller scale energy system as it gathers partners of the entire energy value chain, across all energy carriers, and all countries in Europe. A smaller scale energy system, where we test-bed new ways to innovate and produce new methods as for this report, to better reflect on who we are, and attract new partners to make a difference. This report is the first of its kind, the first of more to come to help us take decisions and make an impact.

Wishing you an inspiring reading.

**Céline Jullien**

*Industry Program Management Officer  
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**Diego Pavia**

*Chief Executive Officer  
KIC InnoEnergy*

# Methodology

## 100 energy priorities

### A KIC InnoEnergy selection

This report provides an in-depth understanding of the global competitive energy landscape, identifying and ranking the top 10 industry and academic players according to their innovation competencies.

**The 100 energy priorities are KIC InnoEnergy priorities, defined in its Roadmaps in the following thematic fields**

(to be found at <http://cip2014.kic-innoenergy.com/thematic-roadmaps/>)

- Renewable Energies (Photovoltaic, Solar thermal, Ocean, Wind energies)
- Clean Coal and Gas Technologies
- Intelligent Energy-Efficient Buildings and Cities
- Smart Grids & Electric Storage
- Sustainable Nuclear & Renewable Energy Convergence
- Energy Efficiency in the industry

## Top 10 players

### A Questel Consulting-KIC InnoEnergy methodology

**The methodology combines 9 key performance indicators (KPI)**

and an adapted weighting and scoring method to make relative comparisons possible across thematic fields and by player type. The selected KPI and corresponding scores concern quantitative and qualitative measures of patents, scientific publications, strategic involvement in each topic, collaboration in R&D, and R&D commercialisation, all viewed as essential to defining innovation competencies.

#### Sources of information

- Professional databases: Orbit®, Thomson Innovation®, Web of Knowledge®, OneSource®.
- Public information: players' press releases, technology transfer offices' websites, financing institutions' websites (Cordis, enGrant Scientific), thematic fields' websites (news, associations), and players' annual reports.
- KIC InnoEnergy survey: to partners and to 850 top industry and academic players worldwide.

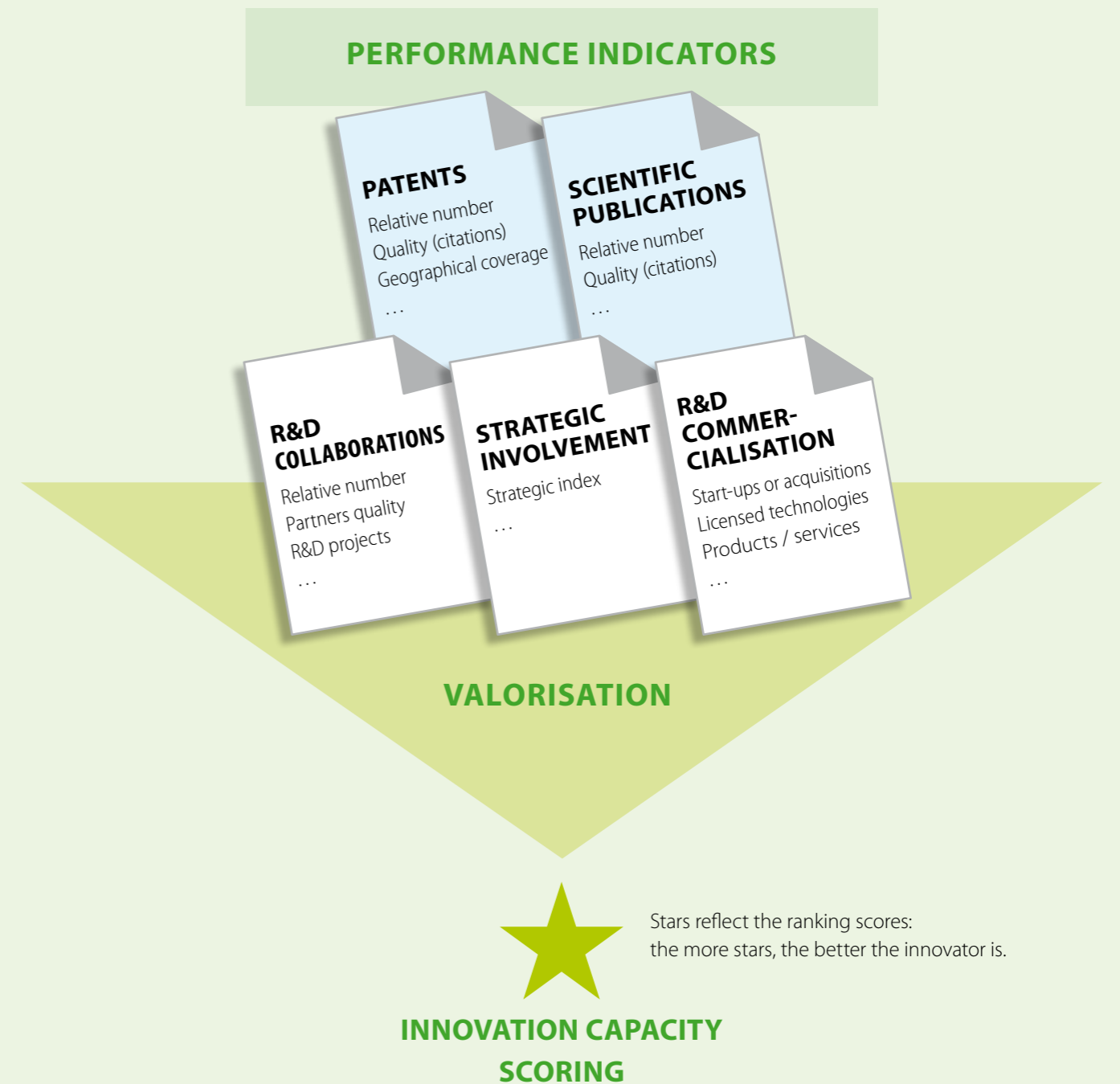
#### Report summary in figures

- ~150,000 Patents
- ~180,000 Scientific Publications
- 1,890 identified R&D collaborations
- 340 identified acquisitions /created start-ups
- 1,227 identified products /services and licenses
- 2,000 identified and ranked top 10 industry and academic players

#### 9 key performance indicators

- Relative number of patents
- Quality of patents (citations, geographical coverage...)
- Relative number of scientific publications
- Quality of scientific publications (citations)
- Relative number of industrial and academic collaborations (R&D projects)
- R&D Project Partners quality
- Strategic index (relevance of the priority for the player)
- Existing Spin-offs, new branches or subsidiaries, or acquired companies
- Commercialised products/services, licensed technologies

## Key Players identification process



#	ASSIGNEE	COUNTRY	SCORING		
			IP	PUBLICATION	VALORISATION
1	Company / Institution	Headquarters	★	★★	★★★



# Wind Energy



# Ocean Energy



# Solar Photovoltaic System





# Solar Thermal Electricity



# Intelligent Energy Efficient Buildings and Cities



# Smart Grids and Electric Storage

# Smart substation with decentralised measurement and switching

The segment includes smart substations or technologies for automation of substations. This cluster also includes switching schemes for automated management of the loads, quality and voltage of the electricity in the regional grid.

## INDUSTRY PLAYERS

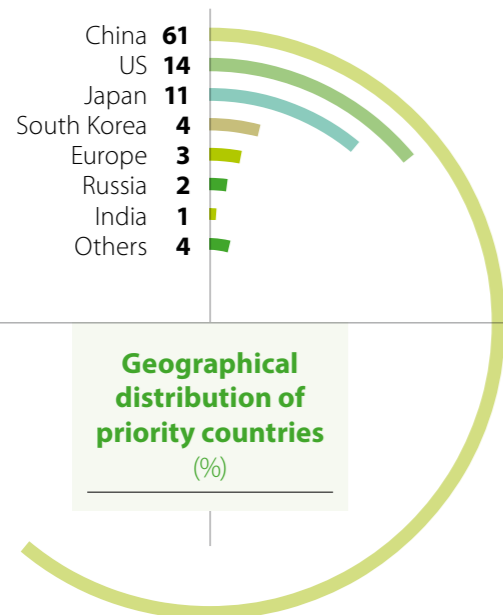
1,869  
Patent Families

Inventive activity has been increasing very rapidly since 2007, much more rapidly than the average annual growth rate observed for the whole renewable energy sector. The segment includes the largest electric utility in China (State Grid Corp China). Industries included in the top 10 have been involved in acquisition or joint venture processes. ABB is listed as one of the top industrial players due to important collaborations and products on the market. State Grid Corporation of China, which holds the largest amount of patents, is the world's largest electricity utility. There are several partnerships in these segments: Schneider Electric has collaboration agreements with Alcatel-Lucent, Cisco and IBM; ABB has collaborations with Asian universities listed in the top academic players: Tianjin University and Chongqing University.

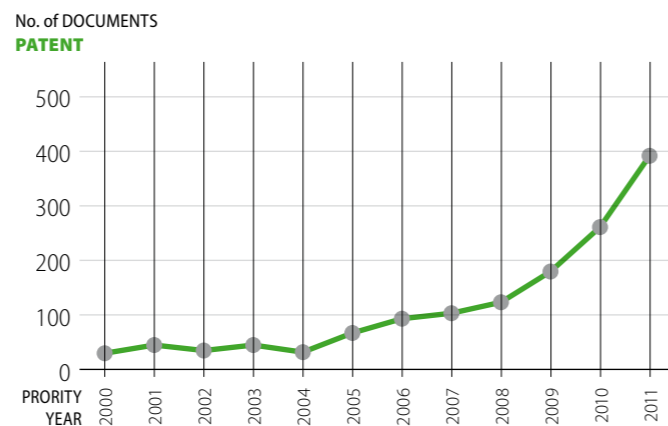
25.3  
% CAGR 2000-2011

### Top 10 reference Companies

#	ASSIGNEE	COUNTRY	SCORING	
			IP	VALORISATION
1	ABB	Switzerland	★★	★★★★
2	General Electric	United States	★	★★
3	Siemens	Germany	★	★★
4	State Grid Corp China	China	★★	★
5	Toshiba	Japan	★	★★
6	Hitachi	Japan	★	★
7	Fuji Electric	Japan	★	★★
8	Schneider Electric	France	★	★★
9	Beijing Sifang Automation	China	★	★
10	Schweitzer Engineering Lab	United States	★	★



### Evolution of patent filings



## ACADEMIC PLAYERS

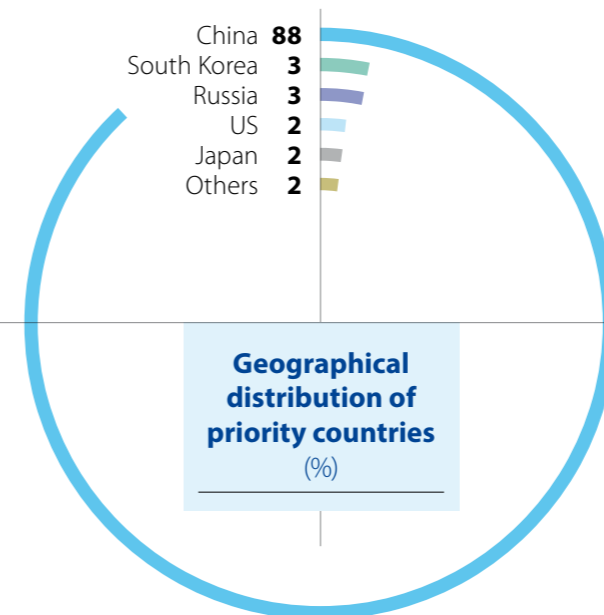
429  
Patent Families

Academic players are mostly Asian but the University of California and CNRS are also part of the 10 most innovative academic players. Both players have fewer patents than the others but own many relevant publications. The top 10 academic players have several partnerships with industrial players in this segment, evidencing important research and product development activity.

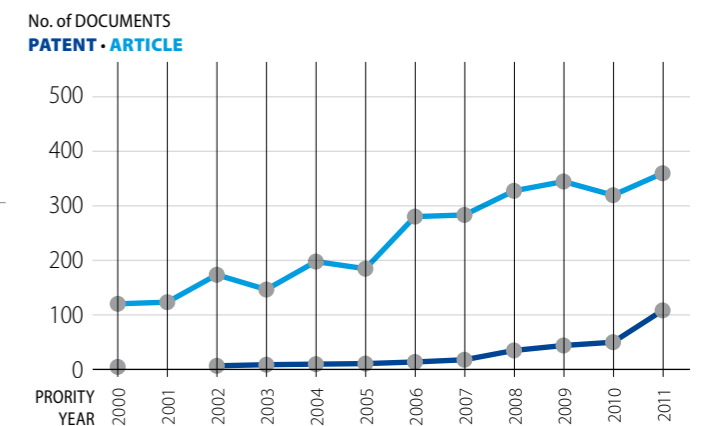
43.3  
% CAGR 2000-2011

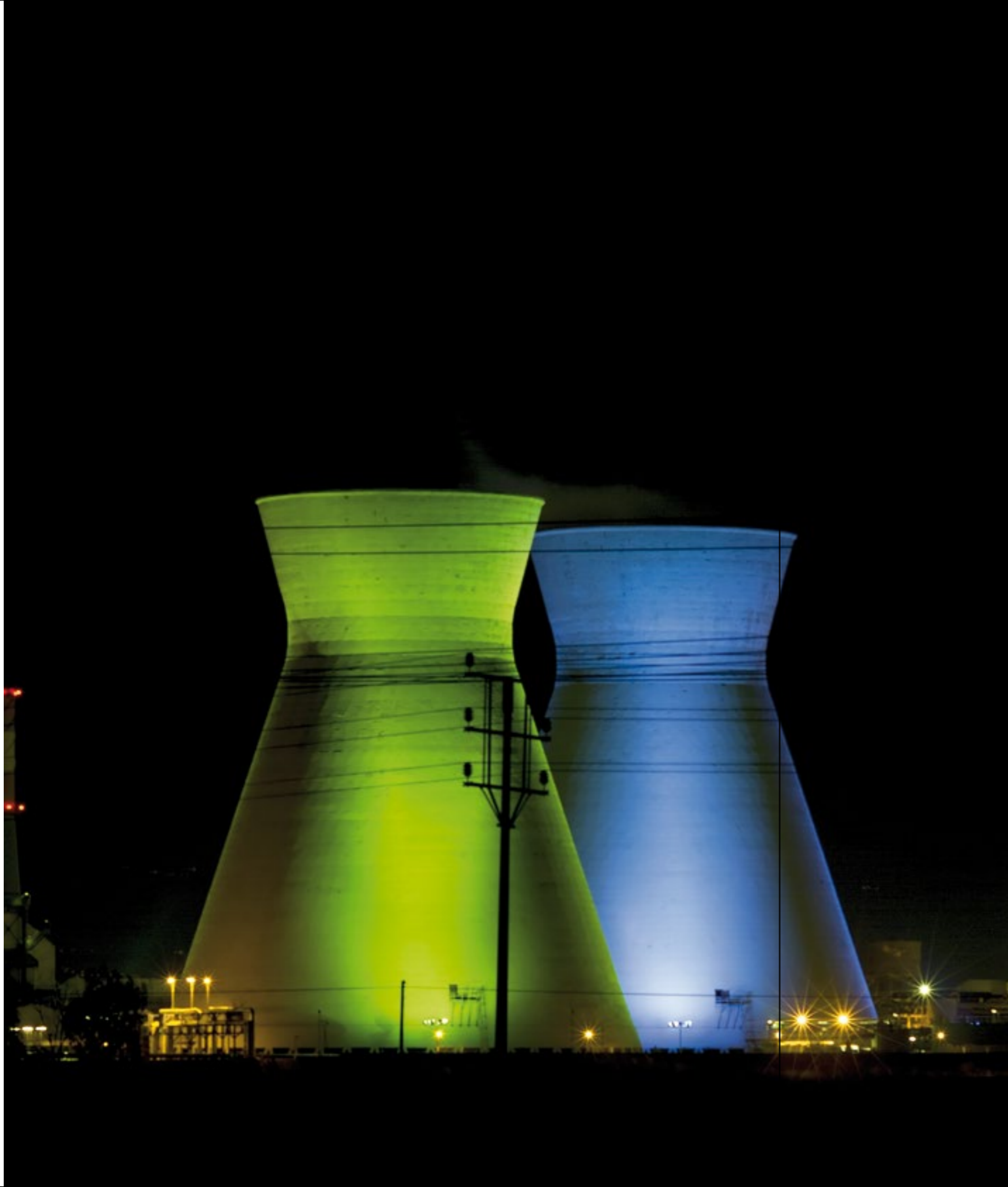
### Top 10 reference Research Institutions

#	ASSIGNEE	COUNTRY	SCORING		
			IP	PUBLICATION	VALORISATION
1	CEPRI- China Electric Power Research Inst	China	★★		★
2	Univ California	United States	★	★★	
3	Chongqing University	China	★★		★
4	CAS - Chinese Academy of Sciences	China		★★	★
5	North China Electric Power University	China		★★	
6	Shanghai Jiaotong Univeristy	China	★★	★	
7	Korea Electro Technology Research Inst	South Korea		★	
8	CNRS	France		★	★
9	Tianjin University	China			★
10	Tsinghua University	China		★★	



### Evolution of patent filings and article publications





# Renewable Energy Convergence



# Clean Coal and Gas Technologies

# About KIC InnoEnergy



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KIC InnoEnergy is headquartered in the Netherlands, and develops its activities across a network of offices located in Belgium, France, Germany, the Netherlands, Spain, Portugal, Poland and Sweden.

KIC InnoEnergy is committed to reducing costs in the energy value chain, increasing security and reducing CO<sub>2</sub> and other greenhouse gas emissions. To achieve this, the company focuses its activities around eight thematic fields:

- Electricity Storage
- Energy from Chemical Fuels
- Sustainable Nuclear and Renewable Energy Convergence
- Smart and Efficient Buildings and Cities
- Clean Coal Technologies
- Smart Electric Grid
- Renewable Energies, and
- Energy Efficiency



KIC InnoEnergy is funded by the EIT. The EIT is an independent body of the European Union that was established in March 2008. Its mission is to increase European sustainable growth and competitiveness by reinforcing the innovation capacity within the European Union.

For more information on KIC InnoEnergy please visit: [www.kic-innoenergy.com](http://www.kic-innoenergy.com)

## KIC InnoEnergy partners over Europe.



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