CONTRIBUTING TO THE SUSTAINABLE ENERGY TRANSITION:
AXA’s perspective as a global insurer
We are in the midst of a complete energy revolution. 2015 marked the turn with 195 countries, including China and the US, agreeing to limit global warming to below 2°C. Beyond government-led initiatives, more and more private players are entering the renewable energy market, and investments are soaring worldwide at an unprecedented rate, notably in emerging markets. These trends, as well as an increasingly volatile climate, mean that insurers have an important role to play.

This paper focuses on renewable energy and AXA’s role in contributing to the green energy transition. As a large global player and investor, we must monitor our own activity and investments to limit our carbon footprint and enable the growth of renewable energy solutions. As an insurer, we play our role to help our clients best understand, prevent and insure various risks.

Read on if you would like to learn about how AXA is contributing to the green energy revolution.

"As insurers, our main role is to protect. By developing innovative insurance solutions to mitigate risk in all phases, from construction to operation and maintenance, to energy production, we, at AXA, are willing to actively support the green energy revolution.”

Gaëlle Olivier, CEO of AXA Global P&C
2015 marked the turn for truly exceptional initiatives with regards to renewable energy, proving that a global energy transition is well under way. During the United Nations Framework Convention on Climate Change’s (UNFCCC) 21st Conference of the Parties (COP21) in Paris, 195 countries agreed to limit global warming to well-below 2 degrees Celsius, a historic climate agreement. High-profile agreements were made by G7 and G20 governments including China and the US, to accelerate access to renewable energy and to advance energy efficiency. The United Nations General Assembly adopted a dedicated Sustainable Development Goal on Sustainable Energy for All (SDG 7). Additionally, precedent-setting commitments to renewable energy were made by regional, state and local governments as well as by the private sector. According to BMI research, total renewables installed capacity is forecasted to grow by 10.5% in 2016, and to almost double by 2025.

2015 was the first year when investments in non hydro renewables was higher in developing countries than in developed countries, with USD 156 bn invested, mainly in China, India, and Brazil.

Per Bloomberg energy finance analytics, more than twice as much money, about USD 260 bn, went into clean energy compared to non-renewable energy in 2015.

“In 2015, 90% of the world’s global energy added to our grids was clean energy: renewable and solar.”

Danny Kennedy,
Managing Director of the California Clean Energy
A soar in renewable energy investments

In 2015, global investments in renewables reached a new record, with investments in developing countries surpassing those of developed countries. 2015 also marked a significant increase from private investors¹.

Global new investment in renewable energy: split by type of economy, 2004–2015, $bn

New investment volume adjusted for re-invested equity. Total values include estimates for undisclosed deals. Developed volumes are based on OECD countries excluding Mexico, Chile, and Turkey.

Source: UNEP, Bloomberg New Energy Finance

Technology as a solution

In parallel with growth in markets and investments, we are experiencing continued innovation with regards to renewable energy technologies, energy efficiency improvements and increased use of smart grid technologies. We also see significant progress in hardware and software to support the integration of renewable energy as well as progress in energy storage development and commercialization. In the face of climate change, certain experts are betting on technology as a solution. For example, Bill Gates founded the Breakthrough Energy Coalition, a government and private-investor-led coalition that focus on early stage companies that have the potential of an energy future that produces near zero carbon emissions and provides everyone with affordable, reliable energy.

AXA: As an expert in the field, how would you define renewable energy?

Harriet Bulkeley: From my perspective, renewable energy simply means energy that can be renewed, so it cannot rely on something that is a one-off resource that could be depleted. Anything where you have not got a solution for the waste is not green - you have to look at the full cycle. Nuclear power, from my perspective, is neither renewable nor green, as it relies on uranium, a depletable source just like fossil fuels, which you have to dig out of the ground and that will run out at one point.

AXA: Where are companies investing?

H.B.: These corporate actors are becoming investors in energy systems. Companies are not only installing their own systems on, for example, office buildings, but are also investing in energy generation quite far from where they are based. For example, in East Africa and South Africa large corporations in the IT sector are investing in renewables driven both by sustainability concerns, but also for economic reasons as they seek to secure access to electricity on which their products depend, and they are choosing renewables because their comparative costs have decreased.

AXA: What trends have been observed in the past few years with regards to renewable energy?

H.B.: We have seen a growing role for private sector actors outside traditional energy companies driving the energy transition. 20 years ago, energy systems were largely governed by a national government or monopoly utility. Today, we see many more interests in energy markets, and various private sector actors driving different kinds of transitions. For example, initiatives such as the Renew100 (RE100) initiative involves large corporations pledging to work towards 100% renewable energy supply. Large corporations are also investing their own resources in securing their own energy production, and for this they are using renewables. We also see private companies becoming energy generators and retailers, building energy plants, using the energy generated, and selling excess on to consumers.

AXA: What trends are we seeing in developed countries?

H.B.: One trend that we have observed mostly in the more prosperous regions of Europe, North America, Asia and Australia is the drive to collective renewable energy provision and community energy-based schemes. This has been particularly interesting in the UK, but also in Germany. It is essentially collective ownership of energy resources. For example, you might have an energy cooperative, where people invest small amounts of money but collectively they might have sufficient resources to build solar panels on a nearby school, and then the electricity either goes to the nearby school and they make small amounts of return on any profit from selling their supplement energy. It is a very interesting model of small-scale, not-for-profit ownership of renewable energy.
AXA: How do we take those kinds of models, which have worked where people can afford to take risks, and put them into contexts where electricity provision is currently lacking?

H.B.: Although proven they can work, replicating those schemes in developing countries is challenging. For example, we could imagine those types of models of small-scale, decentralized electricity generation collectively owned, working in cities across India, where power is only available for say six or seven hours a day. The question is, how do you organize that, how do you invest it, how do you insure it and enable it to happen, where people haven’t got the kinds of lifestyles that enable them to put their own resources into it? For me, much of the solutions in reaching renewable energy solutions lie in how we think about the role of the grid and what kinds of new systems we can imagine. The technology at the end of the grid, either producing or consuming the power, is not going to be enough. We’ve got to think about the wires that connect the two and how we can imagine new models for developing smart, distributed energy grid systems.

Can you give an example of a successful project in a certain city?

H.B.: One inspiring example is a project conducted in a community outside of Stellenbosch, South Africa, called the iShack project. It is a collective, not-for-profit business model. (Funded by the South African Government’s Green Fund, the iShack Project provides solar electricity on a pay-for-use basis, to residents of an informal settlement in Stellenbosch (Enkanini), South Africa.

To find out more, check out their website http://www.ishackproject.co.za/.

AXA: What are three key takeaway messages regarding the green energy transition in 2016?

H.B.: Firstly, developed countries and developing countries are witnessing different kinds of transition, and this also varies at the urban scale. Secondly, we are witnessing a whole range of new actors getting engaged in the energy domain, from large corporations to community actors. Thirdly, energy generation technologies only hold part of the answer, we need to change our approach to transmission and demand if we are going to witness a real energy transition.

AXA: What are some risks faced by renewable energy plants?

H.B.: Because of uncontrollable factors such as adverse weather conditions, power facilities cannot run all the time. Their intermittency is also something that makes people concerned about their reliability. Yet in many of the growing economies such as Brazil, Mexico, South Africa, India and some parts of China and Southeast Asia, where there is a need to build and generate energy, intermittency of supply is a daily reality and building any form of new capacity is seen as beneficial. In Western Europe, North America, and Australia, there is more work to do around renewable energy generation capacity and getting used to new ways of managing power that enable us to phase out existing capacity.
INSURERS PLAY A KEY ROLE IN ACCOMPANYING THE GREEN ENERGY TRANSITION

In response to the threat of climate change, every actor in society, whether they may be an individual citizen, an NGO, the private sector, or a government, has their role to play. These roles range from proactive, such as taking initiatives, developing programs and policies, and adopting strategies, to support roles, including financing, advisory roles, R&D, and more.

Insurers can thus be game changers in a few ways, playing both proactive and support roles. As a large group, AXA leverages its investment capacity to finance green, sustainable energy projects. Secondly, AXA contributes through R&D and prevention dimensions. AXA also plays its role as an insurer, through sophisticated insurance products including property and casualty insurance as well as parametric insurance to cover energy production, in order to smooth clients’ earnings. These insurance products aid in securing external investments on renewable energy projects.

Since 2015, private investors have significantly stepped up their commitments to renewable energy. “The year 2015 witnesses both an increase in the number of large banks active in the renewables sector and an increase in loan size, with major new commitments from international investment firms to renewables and energy efficiency. New investment vehicles – including green bonds, crowdfunding and yieldcos – expanded during the year.”

AXA as a Responsible Investor
AXA, as one of the largest insurance company and thus one major asset owner in the world, is committed to and is currently financing renewable energy infrastructures, on both equity and debt sides, on condition that these renewable energy projects are meeting AXA’s internal guidelines in terms of risk and return. More accurately, AXA is searching for decent yield in infrastructure debt, and can also find duration thanks to fixed rates infrastructure projects. On the equity side, the financial interests lay in predictable and stable cash flows.

AXA has also demonstrated its commitments towards climate risks and responsible investments by several initiatives:

- AXA is on track to reach its €3bn target of Green Investments by 2020. Green investments include Green Bonds, Green infrastructure debt and equity and Impact investments.
- AXA provides ESG rating to the full spectrum of its fixed income and equity assets and most of its property. Besides, AXA is currently integrating ESG criteria in the management of its fixed income and equity assets.
- In 2015, AXA also divested from the companies most exposed to coal-related activities, representing a divestment of €0.5 billion.
- As a signatory of the Montreal pledge, AXA is monitoring the carbon footprint of its portfolio.

2 Ren21, 2016
Climate change is a direct risk to our business. Both on our liabilities - the claims we pay out - and on our assets - the value of our investments. But climate change also presents us with unprecedented opportunities for action. The insurance sector can play an important role in investing in new technologies, in building greater climate resilience and in helping bring about the behavior changes we will need if we are to create a genuinely sustainable, low-carbon economy.

Overall, we see our role as three-fold:
- Understanding, managing and modeling risk.
- Repairing where there is damage and preventing future damage
- Through our assets and liabilities: on the one side, providing and pricing risk (and, by doing so, helping influence behavior); on the other through where we choose to invest

AXA’s strategy regarding climate change is thus to leverage its risk management expertise to better understand and prevent risks and to mobilize its investment capacity to finance and encourage the energy transition. This strategy addresses both the “mitigation” and the “adaptation” dimensions of climate change.

As a large corporation, AXA reduces its direct environmental impact by managing its energy, paper and water consumption, as well as carbon emissions and waste. As an insurer, AXA also promotes environmental protection awareness amongst its clients, contributing to improving the understanding of global and local environmental risks. More recently, as an investor, AXA measures and discloses the carbon footprint of its investments and strives to integrate Environmental, Social and Governance factors into its investment processes.
**ANTICIPATING AND PREVENTING**

**ANTICIPATING AND PREVENTING CLIMATE-RELATED RISKS**

**Anticipating:** enhancing knowledge on climate risks through the AXA Research Fund

**RESEARCHING TODAY TO BETTER PROTECT TOMORROW**

As a global insurance leader, it is part of AXA’s corporate responsibility to help build and share knowledge on risks, in order to better protect people and the planet.

The AXA Research Fund, the Science Philanthropy initiative of the AXA Group, supports global fundamental research to understand and better prevent environmental, human and socio economic risks. Since 2007, €149M have been committed to 492 research projects in 33 countries. In the category environmental risks, AXA supports around 100 fundamental research projects on climate risks and aims to award 35 million euros to such projects by 2018, covering the whole range of issues relating to climate change: impacts on urban development, migration trends, consequences for health and biodiversity, etc.

**THE TWO-FOLD MISSION OF THE AXA RESEARCH FUND**

The AXA Research Fund supports academic innovation carried out by top-tier researchers all over the world. It provides researchers with the means and freedom to complete their work successfully, so that they feel encouraged to explore new avenues.

Supporting research dissemination goes beyond funding: AXA also uses its corporate networks and communications resources to help selected scientists go one step further in sharing their knowledge with a broader audience, thereby empowering them to actively nurture public debate on risks facing our societies.

**Preventing:** AXA focuses on reinforcing climate risk prevention services to help clients better anticipate and adapt to the changing climate

New and rapidly evolving risks are emerging from the strong financial and technical investment in renewables on a global scale. Risk prevention and mitigation are two of the key drivers to securing a successful energy transition.

AXA MATRIX Risk Consultants offers a broad variety of dedicated expertise and solutions for risk management and risk prevention. Our global network of professionals combines proactive and comprehensive collaboration to support our clients in identifying, assessing and controlling risks leading to pragmatic risk management solutions.

For renewables, AXA MATRIX Risk Consultants helps clients understand and minimize their installation, operational & liability risks. With more than 160 engineers, including special qualified engineers to access offshore sites, we provide globally valuable risk consulting support to secure proper installation and operation of green electricity generation.

Our services for major Original Equipment Manufacturers (OEMs), Contractors, Renewable Plant Owners & Operators and Utilities include:

- Risk Engineering for on and offshore projects
- Review of method statements for transportation of critical key components
- Continuous Risk Management Support for Renewable Plant Operation as well as Offshore Transmission and Distribution Facilities
- Dedicated Natural Hazard portfolio analysis
- Supply Chain analysis for OEMs to support sustainable reduction of cost of electricity generation per kWh.
What will the renewable energy insurance industry look like in 2025?

By 2025, the renewable energy industry will be much larger than it is today. The industry is growing at an impressive rate, proliferating in new and emerging markets, the technologies are expanding and improving, and new players are entering the supply chain.

According to Lloyds, prior to 2010, the industry was mainly concentrated in Europe and the United States, but over the past 5 years it has proliferated to emerging markets. The industry has always been growing at a high rate, but in recent years we have seen a large shift from the northern to the southern hemisphere, Australia, South Africa, Brazil, Chile, but also in European and US offshore wind projects.

Technological innovations are particularly coming from China, North Korea, and Japan, entering the photovoltaic market.

Bloomberg Finance estimates that by 2020, a 50% increase in renewable energy investment is expected, likely to produce more than a doubling of insurance spending in six of the world’s leading renewable energy markets alone. A 2011 report from the Intergovernmental Panel on Climate Change found that the technical potential of renewable energy technologies vastly exceeds current global energy demand. According to the report, more than 97 percent of this potential has yet to be tapped.
FOUND: A NEW ENERGY LINE OF BUSINESS

AXA Corporate Solutions, the AXA Group entity specialized in insurance solutions for large multinationals, has established a dedicated energy insurance business.

This business centralizes the huge pool of experience gained in the renewable energy sector through our operations all over the world. This maximizes the knowledge and value offered to our clients. These benefits include the ability to serve the entire lifecycle of the project through Construction, Liability and Property covers.

Such ‘traditional covers’ have evolved significantly over the last 5-10 years and offer developers a highly equitable and robust risk transfer solution.

For the traditionally ‘uninsurable’ risks we work in partnership with our parametric solutions team. Together we can provide a truly holistic solution, helping to sustain the growth of the renewable energy sector.

PROPERTY & CASUALTY SOLUTIONS FOR RENEWABLE ENERGY

PROPERTY & CASUALTY INSURANCE

From deep seas to arid deserts, renewable energy projects continue to push the boundaries of technology in some of the world’s harshest environments. This means that the risks are becoming more numerous and complex. However the return on investment in renewable energy projects can be significant if the risks are effectively minimized, managed and transferred throughout the lifecycle of the asset.

Typical risks include natural hazards, mechanical breakdowns, serial losses, foundation failure and cabling issues. Maximum losses can easily reach up to a billion dollars if the damage results in business interruption.

Case Study: Rampion Offshore Windfarm

The wind farm is situated in the British Channel approx. 13 km offshore and corresponding to the stretch of coast extending from Worthing to Newhaven off the Sussex coast. The 116 Vestas V112 turbines will serve the farm with a total capacity of 400MW and will produce roughly 1,300 GWh of renewable energy per year. This will be enough to deliver energy to 300,000 households and will save 600,000t CO2. The wind turbines will be erected on mono-piles in a water depth of up to 40m.

AXA is the leading insurer of the project policy: Erection All Risks

Typical claims scenarios of offshore wind risks:

- Wind and wave catastrophe
- Hull impact
- Cable installation
- Installation and handling errors
### EXAMPLES OF P&C COVERS

<table>
<thead>
<tr>
<th>Property</th>
<th>Liability</th>
<th>Construction</th>
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<tr>
<td><strong>Property Damage (all risks)</strong>&lt;br&gt;Property damage ‘All-Risks’ cover indemnifies the insured premises against all losses and damages, except those which are excluded, up to the applicable policy limit/sub limit. Cover can be provided on a list of sites or an individual location.</td>
<td><strong>General Contractual Liability</strong>&lt;br&gt;Liability that one party assumes on behalf of another via a contract is called contractual liability. Coverage for contractual liability is automatically included in a general liability policy. The policy covers bodily injury or property damage for which an insured would be liable if the contract did not exist. The policy also covers liability assumed by an insured under an insured contract, if the injury or damage occurs after the contract has been executed. Insured contracts are covered as an exception to the exclusion. Thus, coverage is provided for any contract engaged in during the policy period that meets the definition of insured contract.</td>
<td><strong>CAR / EAR (construction all risks / erection all risks)</strong>&lt;br&gt;CAR/EAR Cover indemnifies the insured premises against all losses and damages incurred in the construction and/or erection of works, except for the listed exclusions, and up to the applicable limit or sub-limit. This cover can be extended to offer (amongst others) financial indemnity to damage to plant, equipment, works offsite and materials offsite.</td>
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<tr>
<td><strong>Named Perils</strong>&lt;br&gt;Property named perils cover indemnifies the insured premises against all losses and damages for all losses from a named peril, often including fire, flood, windstorm, machinery breakdown, and many more. Cover can be provided on a list of sites or a single location.</td>
<td><strong>Third Party Liability (TPL)</strong>&lt;br&gt;TPL covers the insureds liability to pay third parties compensation for damage to third party property or bodily injury.</td>
<td><strong>Delay in start-up (DSU)/Advanced Loss of Profits</strong>&lt;br&gt;DSU/ALOP provides insureds with financial indemnity against the loss in profits occurred following a claim under a CAR/EAR policy that results in a delay of completion of the project. This may result in cover for increased loan interest charges and/or loss of net revenue.</td>
</tr>
<tr>
<td><strong>Business Interruption (BI)</strong>&lt;br&gt;Business Interruption Insurance cover indemnifies the insured premises against all losses and damages for all covered costs arising directly from an insured loss. For example this cover can include increased costs of working whilst damage is repaired.</td>
<td></td>
<td><strong>Maintenance</strong>&lt;br&gt;Maintenance cover provides the insured with financial indemnity against any damage caused to the works during the undertaking of maintenance, servicing or finishing works (de-snagging) during a pre-defined period after the practical completion of the works, normally 12 or 24 months.</td>
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Increasing weather volatility and weather extremes are causing a surge in demand for renewable energy insurance. As a matter of fact, there were 198 natural catastrophes in 2015, the highest number ever recorded in a single year. However, there was a large difference of USD 55 billion between total and insured losses, which highlights the lack of insurance protection globally against catastrophe events. Indeed, the energy output of a wind farm, a solar farm or a hydropower plant is highly dependent on the weather conditions present at the site. According to the IPCC, as a consequence of climate change, the occurrence of weather anomalies has increased greatly. In the past 50 years, the frequency of weather catastrophes linked to climate change was actually multiplied by 5. Weather anomalies cause unpredictability of energy production results and can also be a cause of under-production of energy. Indeed, renewable sources have some disadvantages: they are intermittent sources – the sun does not shine every day, all day, and likewise the wind does not blow all the time.

In 2014, AXA launched a department entirely dedicated to parametric insurance, offering a plethora of customized parametric insurance solutions to clients of all types and sizes. These innovative insurance products protect our customers exposed to weather risk. The cover is designed using an independent and verifiable index that is correlated to the company’s cost structure or revenues. In many cases, the parameter is a weather index, such as wind speed, wave height, solar radiation, or rainfall. Once the index is reached, payout is triggered and the client receives compensation within a few days. Parametric insurance is particularly well adapted to renewable energy. As energy production directly depends on weather, the insurance product can accurately reflect the clients’ risk, thus smoothing revenues from energy production over the years. Furthermore, the increase in weather anomalies experienced as a consequence of climate change means that production is more and more unpredictable, and securing investments is key.

“Certain renewable energy projects would not have seen the light of day without an insurance dimension, which reassures the investor on the sustainability of the project.”

Tanguy Touffut, Global Head of Parametric Insurance at AXA Corporate Solutions

Sigma 3, 2016
How does it work concretely?

Let us take the example of a solar photovoltaic plant, seeking revenue insurance against lack of solar irradiance. A solar plant is very exposed to the risk of the sun not shining, which will impact its revenue month-to-month and year-to-year. In order to create the most relevant cover, we work together with the client to best understand their insurance needs. We model photovoltaic production, agree upon the risk period, take note of the solar plant type, location, and the installed capacity. To design the best index for existing plants, we use historical production data over the longest period possible and correlate it to our weather data. With this parametric cover, the client would have received compensation during those years where lack of sun caused a decrease in energy production.

Sample cover structure

<table>
<thead>
<tr>
<th>Identification of main risk</th>
<th>Lack of sun leads to a decrease in energy production</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>Modelled daily solar energy production</td>
</tr>
<tr>
<td>Location</td>
<td>Solar panel farm</td>
</tr>
<tr>
<td>Risk period</td>
<td>e.g. full year (September 1st to August 31st)</td>
</tr>
<tr>
<td>Trigger</td>
<td>e.g. yearly production decrease below 5% of the average (P50)</td>
</tr>
<tr>
<td>Payout</td>
<td>To be defined contractually based on price per kWh agreed upfront</td>
</tr>
<tr>
<td>Limit</td>
<td>e.g. 10 million €</td>
</tr>
</tbody>
</table>

Simulated revenues with parametric insurance cover (in M€)

- Insured
- Smoothed revenues with parametric cover
- Revenues without parametric cover
Parametric insurance is a means of smoothing revenues year-to-year. Without a parametric cover, the client would be left with very volatile, unpredictable revenue depending on the weather conditions and other factors. With our cover, the client can guarantee smoothed revenues. Through satellite imagery, we are able to capture more and more sophisticated weather data that we were unable to capture previously.

We expect that, thanks to the continuous advancements in technology and Big Data Processing Methods, that parametric insurance will continue to grow greatly. Indeed, parametric insurance has improved greatly over the last decade.

AXA’s parametric insurance team has developed the global reach and technical expertise to manage various risks in this evolving industry. The team operates worldwide. To find out more about our parametric insurance, check out our white paper on our website at www.axa-corporatesolutions.com.
Today’s fast-evolving, complex world generates an ever-increasing number of risks that cannot be covered by traditional insurance or financial products. Corporations are increasingly interested in Risk Financing Solutions/Alternative Risk Transfer (A.R.T.) solutions to mitigate the impact of losses on operating accounts (loss of income, loss of profit, additional working costs, costs & expenses, loss of assets), by providing a dedicated budget to finance future losses and pooling the exposures of various subsidiaries and/or operating entities. This is also an important concern for renewable energy activities.

Those risk financing facilities provide organization with protection against financial loss arising from risks including penalties, non-damage business interruption, loss of access, reputational or brand damage, supply shortage, loss of footfall arising from a wide range of events such as changes in legislation/regulation, political risk, cyber-crime and IT failure, pandemic/epidemic, terrorism threat, exceptional climatic events in addition or alternative to traditional parametric transfer…

AXA CS’ A.R.T. department works closely with clients and brokers, utilizing their vast experience to design tailor-made mechanisms to smooth P&L volatility. Our experts are able to design and implement structured protection programs with or without captives, integrating risk financing for non-insurable risks with traditional covers to set up a holistic solution. This mechanism combined with the traditional covers build an integrated, legally and regulatory compliant solution to fit exact risk exposure profile. Those integrated solutions are supported by our robust claims organization led by highly experienced claims managers.
Conclusion
In the face of climate change, insurers’ role is shifting to support the green energy transition. AXA plays two roles, both as a large global investor and as an insurer. In addition to investing in green energies and committing to being a responsible company, AXA focuses on anticipating and preventing, and finally on protecting its clients. AXA strongly believes that through new technologies and innovative approaches, insurance solutions that are adapted to the emerging renewable energy risks will be key to securing investments in sustainable and green energy for the future.