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23e Congrès Mondial de l'Énergie à Istanbul

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23e Congrès Mondial de l'Énergie à Istanbul

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AVANT-PROPOS

Le 23e Congrès Mondial de l'Énergie s'est tenu à Istanbul, en Turquie, du 9 au 13 au 17 octobre 2016 sur le thème « **Énergie : les nouvelles frontières** ». Le Congrès est un temps fort de la vie du Conseil Mondial de l'Énergie qui réunit tous les trois ans plusieurs milliers de dirigeants et d'experts, venus du monde entier. Après Rome (2007), Montréal (2010) et Daegu (2013), le Congrès d'Istanbul restera un « grand crû » par la notoriété des orateurs et la qualité des débats.

La Turquie a été marquée, en 2016, par des actes terroristes et par des événements, mi-juillet, qui auraient pu fragiliser le Congrès. Il n'en faut que davantage remercier nos amis du comité turc du Conseil Mondial de l'Énergie et l'équipe de Londres qui les a épaulés pour avoir, dans ces conditions difficiles, rassemblé près de 5 500 délégués venus de 151 pays et d'avoir permis la tenue d'un Congrès de haut niveau, dans des conditions très satisfaisantes. 56 ministres, venus de 48 pays, et 266 orateurs, venus de 78 pays, ont participés aux 50 sessions organisées pendant les quatre jours du Congrès, créant ainsi une dynamique de réflexion et d'échanges exceptionnelle.

La participation de quatre Présidents — Ilham Aliyev (Azerbaïdjan), Vladimir Poutine (Russie), Recep Tayyip Erdoğan (Turquie) et Nicolás Maduro (Venezuela) — au Congrès, dans une même session historique, a contribué au succès et à la notoriété de cet événement.

Le Conseil Français de l'Énergie a rassemblé les déclarations et les messages-clés, les temps forts des sessions, des articles diffusés aux congressistes et de courtes synthèses des études publiées à Istanbul. Je souhaite particulièrement remercier les trois grands témoins (Olivier Appert, Jean-Marie Dauger et Bruno Lescoeur) qui ont participé au Congrès et ont accepté de rédiger des tribunes, ainsi que les quatre jeunes docteurs (Audrey Berry, Alena Kotelnikova, Xavier Lambin et Marie Petitet) dont le Conseil Français de l'Énergie avait permis la participation au Congrès et publie aujourd'hui le rapport.

L'activité du Conseil Mondial de l'Énergie a repris au lendemain du Congrès, organisée, relayée, déclinée en France par le Conseil Français de l'Énergie. Je vous donne d'orès et déjà rendez-vous pour le 24e Congrès Mondial de l'Énergie, en septembre 2019, à Abu Dhabi (Émirats Arabes Unis).

Bonne lecture,

Jean Eudes Moncomble

Secrétaire général du Conseil Français de l'Énergie

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Déclarations

ÉNERGIE : LES NOUVELLES FRONTIÈRES

Notre monde s'est engagé dans une Grande Transition initiée par un ensemble de facteurs, notamment le développement fulgurant de nouvelles technologies, une irrésistible révolution digitale, des défis environnementaux planétaires et des modèles démographiques et de croissance en constante évolution. Au cours des prochaines années, cette transformation énergétique va peut-être modifier la manière dont nous produisons et consommons l'énergie. Ceci influera sur les modes de fonctionnement et les fondements économiques des États et des entreprises et conduira à un rééquilibrage des secteurs et des régions dont les effets se feront sentir sur l'économie mondiale.

La prochaine décennie verra émerger les gagnants et les perdants de la transformation énergétique. Pour cette raison, il est indispensable de comprendre dès aujourd'hui la nouvelle donne de l'énergie.

LES NOUVELLES RÉALITÉS DE L'ÉNERGIE

1. Du pic pétrolier au pic de la demande

Le débat sur le pic pétrolier est désormais obsolète : en réalité la demande d'énergie par habitant atteindra son pic d'ici à 2030. Soutenues par les effets de substitutions d'énergies primaires, les réductions de l'intensité énergétique vont s'accélérer à un rythme plus soutenu que la croissance de la demande provenant d'une classe moyenne mondiale en développement. Ce phénomène a donc pour effet de déplacer le débat du « pic pétrolier » vers celui du « pic de la demande » dont l'anticipation de croissance sur les 45 prochaines années devrait être inférieure à 20 %. Ceci aura des effets considérables sur les entreprises énergétiques et leur capacité à réaliser leur anticipation de croissance avec, notamment leur capacité de concrétiser leurs ambitions de croissance qui devront être prises en compte dans leurs stratégies d'investissement.

2. Utiliser le budget carbone

Les efforts pour décarboniser nos économies sont insuffisants : il va falloir accélérer la décarbonisation du PIB mondial à un taux de 6 % par an pour rester en deçà du budget carbone associé à l'objectif climatique de 2°C. Cela va nécessiter des efforts considérables puisque, si l'on suit les tendances actuelles, le budget carbone serait dépassé entre 2045 et 2055, même avec des hypothèses optimistes de réductions de l'intensité énergétique. Les contributions décidées à l'échelle nationale (INDC, Intended Nationally Determined Contributions) convenues lors de la COP 21 représentent environ un tiers du niveau nécessaire prévu. Une transition rapide et réussie des systèmes de transports mondiaux vers des solutions bas carbone représente à la fois l'obstacle majeur et la plus grande opportunité pour atteindre les objectifs climatiques.

Les seuls signaux du marché actuels ne sont pas suffisants pour progresser dans les domaines critiques de l'efficacité énergétique, d'un meilleur stockage de l'électricité, de la pénétration des transports propres et de la nécessité incontournable du captage, stockage et valorisation du carbone. Il sera nécessaire d'adopter des politiques et d'instaurer des cadres institutionnels clairs, ciblés et sans ambiguïté pour renforcer le déploiement à grande échelle de solutions permettant d'accélérer la transition et de guider les choix du consommateur vers les solutions les plus efficaces en termes de coûts et de carbone.

3. Des investissements échoués aux « ressources échouées »

Les changements dans la production de l'énergie présentent un risque sur les actifs existants. Mais, à terme, un nombre croissant de ressources primaires – notamment le charbon, éventuellement le

pétrole - sont susceptibles de rester inutilisées. Même si les combustibles fossiles continueront à occuper une place importante dans le bouquet énergétique, avec une contribution se situant entre la moitié et les deux tiers de nos besoins énergétiques à l'horizon 2060, le charbon pourrait ne représenter que 5 % du bouquet mondial. Le pétrole restera un élément nécessaire au transport et représentera encore 60 % des besoins en énergie de ce secteur ; mais la demande en pétrole s'aplanira. L'âge d'or du gaz devrait se poursuivre, avec des prévisions de croissance de la production situées entre 25 % et 70 % d'ici à 2060.

La stagnation de la croissance du pétrole et la diminution de l'importance du charbon d'ici à 2060 vont déplacer les débats actuels sur les investissements échoués, qui concernent surtout les entreprises, vers les « ressources échouées » qui sont souvent la propriété des États. Ceci pourrait mettre sous tension l'équilibre géopolitique et économique mondial actuel et incitera à élargir le dialogue sur le climat et le carbone.

4. L'évolution de la résilience des systèmes

Depuis 30 ans, les événements climatiques extrêmes ont quadruplé, accroissant la pression sur l'utilisation de l'eau dans la production d'énergie ; les menaces cybernétiques sont à des niveaux élevés ; ces faits contribuent tous à une nouvelle donne dans le secteur de l'énergie.

Avec l'intégration croissante des systèmes énergétiques, la résilience ne se limite plus uniquement à la construction de systèmes plus robustes et à la remise en pleine exploitation de ressources isolées après une perturbation. En cas de black-out de systèmes interdépendants à la suite d'événements climatiques extrêmes ou à d'attaques cybernétiques, c'est le système dans son ensemble qui risque un blocage intégral. Les capacités de redémarrage, la décentralisation des décisions et l'autonomie sont devenus les concepts clé d'une nouvelle approche de résilience « faible » à la différence de la traditionnelle résilience « forte », consistant à construire des systèmes plus résistants. L'exploitation des systèmes dans ce nouveau paysage exige de se doter d'outils différents et de nouvelles méthodes de gestion des risques.

5. La voie de l'innovation

Le seuil critique de la révolution technologique dans le secteur de l'énergie a été franchi. La complexité des marchés de l'énergie s'intensifie, accélérée par la fragmentation des politiques énergétiques, le rythme effréné de l'innovation technologique et le changement des attentes des consommateurs. Ces nouvelles réalités se caractérisent par de plus en plus d'offres à coût marginal quasi nul, des faibles barrières à l'entrée, une intensification de la décentralisation et des pouvoirs locaux, la digitalisation et la marchandisation des technologies, plus de solutions flexibles et rapidement rentables, des investisseurs de plus en plus actifs et des services pour des consommateurs émancipés.

Les énergies solaires et éoliennes poursuivront leur croissance rapide, l'électrification de la consommation énergétique constituant une tendance inéluctable. En pourcentage de la production finale totale, l'électricité pourrait atteindre des niveaux de pénétration de 30 % d'ici à 2060, dont 98 % proviendraient de technologies sans émissions de CO_2, ce qui représente trois fois leur part actuelle (40 % proviendraient exclusivement de technologies solaires et éoliennes, soit dix fois leur part actuelle). Les market designs et business models actuels, mal adaptés requerront des compétences, modes de commercialisation et des solutions de financement entièrement inédits. Dans le même temps, la production d'électricité dépendra à hauteur de 45 % des énergies fossiles avec captage, stockage et valorisation du carbone.

Pour réaliser ce potentiel, il est indispensable de mieux cibler la recherche, développement et démonstration (RD&D). La coordination des initiatives innovantes est nécessaire pour assurer la crédibilité des programmes de décarbonisation.

6. Une gouvernance mondiale en évolution

Le centre de gravité de l'énergie s'est déplacé hors des pays de l'OCDE. Dans un avenir proche, ce sont la Chine, l'Inde et l'Afrique qui définiront le calendrier en matière d'énergie, et ces pays doivent occuper la place qui leur revient dans la gouvernance énergétique mondiale. La gouvernance énergétique mondiale est de plus en plus inclusive et dispose d'un arsenal d'outils de gouvernance mondiale plus complet qu'il y a 5 ans. L'ONU a reconnu un objectif de développement durable en matière d'énergie et la Conférence des Parties a conclu un accord à Paris ; des organisations comme l'Agence Internationale de l'Energie ont engagé le dialogue avec de nouveaux acteurs clé de l'énergie comme la Chine. Le G20 a inscrit la sécurité énergétique à son ordre du jour et la Conférence ministérielle sur l'énergie propre fait également intervenir des pays qui ne font pas partie du G20.

Dans le même temps, de nombreux points importants restent en phase de travail, comme la réduction des barrières commerciales internationales, tarifaires et non tarifaires sur l'échange de biens et services énergétiques « propres » pour promouvoir le développement de systèmes énergétiques « propres », l'introduction de mécanismes de tarification du carbone pour favoriser des investissements adaptés, le renforcement de l'intégration des infrastructures régionales et les mesures d'harmonisation des marchés pour favoriser une allocation efficace des ressources. Il sera important de se concentrer sur ces points et d'améliorer la capacité à répondre avec bienveillance à un engagement citoyen croissant pour concrétiser la transformation énergétique.

7. L'entreprenariat favorisant l'accès pour tous

Même si des progrès ont été effectués, il reste 1,1 milliard de personnes sans accès à l'énergie. La reconnaissance de l'énergie comme septième objectif de développement par l'ONU a permis de donner plus d'attention aux opportunités à fort potentiel et au déploiement rapide des meilleures solutions technologiques. La récente émergence de modèles commerciaux innovants et perturbateurs des solutions énergétiques hors-réseau en milieux ruraux va fournir des opportunités formidables là où les besoins sont les plus importants, en Afrique subsaharienne ou en Asie du Sud notamment. Le déploiement de ces solutions permettra de définir les principaux enjeux de ces marchés de demain et contribuera à éviter l'accroissement des inégalités. Le renforcement des politiques commerciales et climatiques sera important pour le transfert de technologies afin d'éviter de reproduire les erreurs passées. Il est urgent de mettre en place des cadres politiques et institutionnels solides favorisant les approches entrepreneuriales, minimisant les risques et facilitant l'accès aux grands investisseurs.

IL FAUT AGIR

La Grande Transition est inéluctable et mérite une réponse globale et une conduite soignée, basée sur les principes du Trilemme énergétique. Le succès de la transformation énergétique repose sur une coopération politique et économique mondiale d'une ampleur sans précédent. Les dirigeants et la société doivent comprendre ces nouvelles réalités et s'efforcer de continuer à innover tout en maintenant des cadres d'investissements stables. Une pression intense se fera sentir sur les trois dimensions du Trilemme énergétique alors que se renforcera l'aspiration des pays à améliorer la sécurité énergétique, à accroître l'égalité en matière d'énergie et à réduire les émissions de carbone. Une focalisation unilatérale sur certaines priorités finit par créer de nouvelles tensions et par saper le large soutien politique et la stabilité nécessaires pour encourager les investissements. Des approches novatrices seront indispensables pour maintenir l'équilibre des trois dimensions du Trilemme énergétique. Ce n'est qu'avec une gouvernance volontaire que la Grande Transition sera menée à bien et évitera le scénario de faible croissance et de repli sur soi qui déboucherait sur une stagnation du secteur de l'énergie.

Les gouvernements, chefs d'entreprise, investisseurs, et la société dans son ensemble devront réexaminer le contrat énergétique et trouver de nouvelles méthodes permettant

d'éviter les blocages, de favoriser les décisions rapides et de livrer des infrastructures intégrées, efficaces et rentables. Cela passera par la mise en place de solutions de planification urbaine innovantes, des réponses adéquates en termes de résilience et des politiques et cadres commerciaux favorables. Les solutions ne viendront pas uniquement du secteur de l'énergie, mais celui-ci dispose d'une opportunité historique pour montrer l'exemple et fournir le leadership et la force nécessaires à une révolution industrielle de plus grande ampleur.

Il sera nécessaire de faire d'immenses efforts pour nous adapter à cette nouvelle donne, et c'est notre capacité à y répondre qui fera émerger les gagnants et les perdants.

Message du Conseil Mondial de l'Énergie en préambule du Congrès Mondial de l'Énergie, Istanbul, octobre 2016

Référence : version anglaise publiée par le Conseil Mondial de l'Énergie

23 MESSAGES-CLÉS DU CONGRÈS

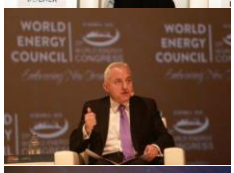
1. La discussion sur le « peak oil » s'est transformée en discussion sur le pic de la demande

"Historically people have talked about peak oil but now disruptive trends are leading energy experts to consider the implications of Peak Demand."
- Ged Davis, Executive Chair, World Energy Scenarios, World Energy Council

"We're going through a time during which supply has outstripped demand. Technology has continued to unlock new sources of supply—notably shale oil and gas in the US. At the same time, global demand growth has slowed from the extraordinary pace of the past 20 years."
- Bob Dudley, Group Chief Executive, BP

"Our own estimates at OPEC are projecting additional demand of 17m barrels, taking it to 120m barrels per day by 2030. We don't' see it plateauing—we see demand continuing to grow and see a continued underestimate of growth in the developing world."
- Mohammad Barkindo, Secretary General, OPEC

2. Le changement climatique est devenu un enjeu majeur ; il agit comme principal moteur de la transition énergétique



"It's a huge and inspiring challenge. Climate change changes everything and much more than climate, because it is the very first time we must meet a global challenge."
- Isabelle Kocher, Chief Executive Officer, ENGIE

"The growth of decarbonisation efforts will bring jobs and improve the quality of life for everyone."
- Tufan Erginbilgic, Chief Executive for Downstream, BP

"The key to the successful transformation lies in a combination of ambition and pragmatism and balancing of climate change, economic and energy priorities. I am confident that our generation will succeed as did our predecessors, providing the future generation with a more robust, responsible and reliable global energy system"
- Khalid Al Falih, Minister of Energy, Industry and Mineral Resources, Saudi Arabia

"I don't know any energy transition that can be done in a decade. It's also a matter of cooperation… No country on its own can solve this and drive the world in the right direction."
- Doris Leuthard, Federal Councillor, Head of the Federal Department of Environment, Transport, Energy and Communications, Switzerland

3. On a franchi le point de basculement d'une transition énergétique mondiale. Il est temps pour les acteurs de l'énergie « d'innover ou de mourir »

"We need to be competitive in a very different way than in the past. We need to be open about new ways to do business…. In previous cycles, as an industry, we have let costs drift up when prices are high, then cut back when prices fall. From now on, the challenge is to build—and sustain—businesses that are good through all cycles."
- Bob Dudley, Group Chief Executive, BP

"A transformative approach to energy is critical to success. Achieving our energy goals, including universal access, energy efficiency and renewable energy will

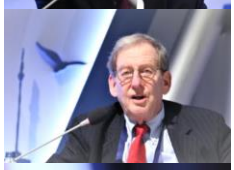
open a new world of opportunity and investment."
- Ban Ki-moon, Secretary General, United Nations

"In the UAE we believe one of the pillars of society is clean energy. There is a role for us as government to enable this shift from being purely dependent on fossil fuels to allowing competition from newer forms of energy. We must all make a commitment to it. You need to look at 2050 and think: what is your plan? What energy mix are you aspiring to? We're trying in the UAE to manage that shift."
- Suhail Mohamed Al Mazrouei, Minister of Energy, United Arab Emirates

"From the political side, the system requires constant adjustments. Companies, on their part, must be ready to be flexible and change their business models accordingly."
- Frank Mastiaux, Chief Executive Officer, EnBW

4. La gouvernance mondiale doit inclure toutes les parties prenantes et les nouveaux entrants

"Countries can share international policies for energy efficiency and clean energy development. China wants to have an effective global governance framework. We support improving energy governance, energy evaluation and energy efficiency."
- Han Wenke, Director General, Energy Research Institute - NDRC, China



"We have to narrow our focus on how to create sustainable energy accessibility for the world. Diversification will involve new technologies. Financing the private sector and technology are the key factors."
- Richard L. Morningstar, Founding Director and Chairman, Atlantic Council

"The challenge of the world today is that governance is overwhelmed. We have geopolitical crises around Eurasia, with rising tensions. We have transformative technologies, bringing enormous benefits. But we lag behind due to political governance. We seem to have a decline in democracy. On overreaching issues, balancing security with equity and sustainability is real challenge."
- Sean Cleary, Founder and Executive Vice Chair, Future World Foundation

5. Les solutions hors-réseau sont essentielles pour le futur énergétique de l'Afrique

"For renewable energy to succeed, government has to play a central place to drive innovation and projects… We are creating incentives, because it is essential to drive the sector."
- Samuel Undenge, Minister of Energy and Power Development, Zimbabwe

"It is important that development partners and policy makers do not stand in the way of innovation. Kenya is fairly light on regulation, which is why a lot of innovation has taken place. The private sector does much better than government in identifying possible commercial solutions… Don't tax too soon, allow the industry to grow and mature. Once regulators and policymakers understand that technology and industry do not always develop in a linear fashion, there will be a fusion of demographics, technologies and finance."
- Mugo Kibati, Chairman, M-KOPA Solar

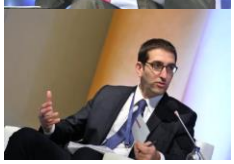
"Technology is moving very rapidly and today we see that off-grid solar is often cheaper than connecting consumers to the grid. The number of people for whom it is cheaper to connect off-grid is increasing all the time… Governments are bad at innovation. When things become more clear then we can apply regulations."
- Simon Bransfield-Garth, CEO, Azuri Technologies

"If we were having a conversation on off-grid power five years ago, we would be talking about it as a transitional thing, now we see that it can actually make a long-term, significant contribution."
- Christina Ulardic, Head of Market Development Africa, Swiss Re Corporate Solutions

6. Efficacité énergétique : la réalité est bien en deçà des attentes

"We are not making enough use of the resources for energy efficiency. This is an issue where more progress definitely has to be shown…For the IEA, energy efficiency is the first fuel."
- Fatih Birol, Executive Director, IEA

"Energy efficiency must be tackled with an international approach, not simply with a few applications here and there."
- Pierre El Khoury, General Director and President of the Board, Lebanese Center for Energy Conservation (LCEC)



"Energy efficiency is one of the main issues that we are concerned with in Mexico." Flores also explained that the country's recent energy reform included integration of clean energy resources, energy efficiency policies and the elimination of subsidies.
- Aldo Flores Quiroga, Deputy Secretary of Energy for Hydrocarbons, Mexico

7. Le trilemme mondial énergétique aide le secteur de l'énergie à modifier ses priorités pour un bouquet énergétique plus équilibré et un accès plus inclusif

"The World Energy Congress is one of the most pre-eminent platforms for action. I commend the World Energy Council for helping shape a sustainability narrative through the Energy Trilemma concept"
- Ban Ki-moon, Secretary General, United Nations

"Energy access and climate change have never been so high on the agenda as now, following the COP 21 Paris Agreement, the UN Sustainable Energy Goals, and the attention accorded these issues by the G20. This shift in energy priorities is bringing greater diversity to the global energy mix, helping to underpin security of supply while increasing sustainability"
- Joan MacNaughton, Executive Chair, World Energy Trilemma, WEC

"The Trilemma index is important for the shift to sustainable energy. In China, we need a sustainable and balanced methodology, which can be found in the trilemma."
- Kang Yanbing, Director, Energy Sustainability Center, Energy Research Institute – NDRC, China

"For policy makers, the Index rankings help structure dialogues on the complex trade-offs in developing and implementing energy policy and regulations that will support secure, affordable and environmentally sustainable energy."
- Francois Austin, Global Energy Practice Leader, Oliver Wyman

8. Le développement du solaire et de l'éolien va se poursuivre à un rythme sans précédent

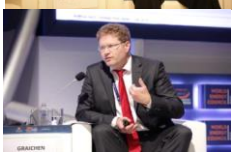
"Renewable energy is the only viable option in the power sector to achieve decarbonisation. In the last few years, we have seen the phenomenal contribution of non-hydro renewables, mainly wind and solar"
- Abid Malik, Managing Director Turkey, ACWA power

"Renewables are mainstream today and continue to be innovative… the industry continues to reinvent itself."
- Jérôme Pécresse, President & CEO, GE Renewables

"We built 25,000 windmills and 26 million solar panels in Germany between 2000 and today. The key to this is ownership." Baake citing a shift in the country's energy landscape with a rate of up to 40% ownership in the renewable generation by private citizens and farmers.
- Rainer Baake, State Secretary, Federal Ministry for Economic Affairs and Energy, Germany

"Solar and wind power will continue their rapid growth. The integration of these intermittent energy carriers into the supply system can be seen as just one of these structural challenges."
- Hans-Wilhelm Schiffer, Executive Chair, World Energy Resources, World Energy Council

9. Les solutions de stockage de l'énergie sont une innovation essentielle au cœur de la transition énergétique



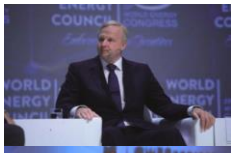
"Storage and transportation are priorities. The cost of storing energy is too high, so it is important to design adequate policies and mechanisms to implement ESS."
- Taehee Woo, Vice Minister of Energy and Trade, Korea (Rep. of)

"Having renewable energy for reasonable costs has required three components in UAE experience – an economy of scale, long term commitment from the Government and interconnectivity with neighbouring countries. The next technological progress we need is in solar energy storage to make this technology even more viable."
- Suhail Mohamed Al Mazrouei, Minister of Energy, United Arab Emirates

"There is tremendous opportunity for storage in renewables. When cost of storage batteries become cheaper then these technologies will become widely used."
- Georges Antoun, Chief Commercial Officer, First Solar

"We need more innovation with electric storage for renewables. Storage prices have come down but we need to see more focus"
- Patrick Graichen, Executive Director, Agora Energiewende

10. La part du gaz naturel et du GNL ne cesse de croître dans le bouquet énergétique



"In BP we are already around 50% natural gas now and heading towards 60% by the end of the decade as new gas projects come on stream… This is an important shift. This is the age of big gas."
- Bob Dudley, Group Chief Executive, BP

"Gas is a driver of energy transition in Europe. We are still in a good situation for security of supply in Europe. It's better than ever."
- Klaus Schäfer, Chief Executive Officer, Uniper

"The only way to sustain economic growth is through the combination of gas and renewables… It would be a mistake to think of gas as a fuel of the past."
- Alexander Medvedev, Deputy Chairman of the Management Board, Gazprom

"In Asia there will be new energy hubs. There will be more customers in the gas market and this will bring a dynamism to the market. These changes will make natural gas and LNG more competitive and safe."
- Shigeru Muraki, Executive Advisor, Tokyo Gas

11. Le marché européen de l'électricité nécessite un redémarrage pour s'adapter aux nouvelles réalités de l'énergie

"It's not even a question of cost anymore. It's a question of system integration. We have to create a new market design. Digitalisation will be extremely important as will be integration into the European single market."
- Rainer Baake, State Secretary, Federal Ministry for Economic Affairs & Energy, Germany

"There needs to be a clear vision of where the market is going. We need to think about what type of capacity we want. We need capacity and flexibility. When you get high levels of renewables on a large scale and an integrated European system, the potential for faults is higher. It needs to be a very flexible system."
- Fintan Slye, Chief Executive, EirGrid

"It's difficult to get results at the regional or European level, and that is because of national aspects. Every European member state thinks of energy as a matter of national security. That's a reality."
- Dalius Misiūnas, Chairman of the Board and Chief Executive Officer, Lietuvos Energija

12. Combler l'insuffisance de financement en infrastructure est une priorité pour l'énergie en Afrique

"In Africa we have all the energy resources we need. We can use coal, gas and renewables. What we need now is investment. To make that happen we need policies, regulations, transparency and of course political stability"
- Elham Mahmood Ahmed Ibrahim, Commissioner, Energy and Infrastructure, African Union

"It cannot be business as usual. We have to build the infrastructure gap quickly in power generation, transportation and distribution."
- Simon D'ujanga, State Secretary for Energy, Uganda

"It is obvious that with dwindling resources, African states cannot close the infrastructure investment gap." Shehuri continued that with the continent's population explosion from more than 900 million in 2006 to over 1.2 billion in 2016, "There is an immediate need to make energy accessible to all, to create employment, empower people and allow investors to get back their returns."
- Mustapha Baba Shehuri, Minister of State for Power, Works and Housing, Nigeria

"Countries need to take ownership and provide credible leadership and political commitment to address these issues. You need to have a long-term plan for reforming your power sector and put your money where your mouth is as much as possible."
- Mansur Muhtar, Vice President, Islamic Development Bank

"In sub-Saharan Africa the market has failed to solve the problem. You need a global solution."
- Suleiman Jasir Al Herbish, Director-General, OFID

13. La Chine se dirige vers un futur énergétique bas carbone

"China has become the worlds' biggest energy consumer, accounting for 33% of world oil consumption. It's carbon emissions now account for one-quarter of the world total. While coal remains the main component of China's energy mix, the country is leading the world in low carbon energies—solar, hydro and wind —with more than 40% of global investment in renewables coming out of China alone".
- Kang Yanbing, Director, Energy Sustainability Center, Energy Research Institute – NDRC, China

"There are a series of developments that are opening the landscape of infrastructure finance and China is at the centre of this change."
- Leslie Maasdorp, CFO, New Development Bank (NDB), China

14. L'intégration régionale est essentielle pour équilibrer le trilemme énergétique mais les dynamiques régionales sont très contrastées

"We need to act quickly on further integration and build new regional infrastructure. This is not an option but an obligation…Electricity is absolutely crucial to react to natural disasters. We need to connect countries together to eliminate all barriers to be able to deploy appropriate answers to these types of situations. Integration is a big opportunity."
- Esteban Albornoz Vintimilla, Minister of Electricity and Renewable Energy, Ecuador

"Asia is facing very different challenges compared to [North] America and Europe. There, they are facing a grand energy transition. For us we have the challenge of energy access and energy transition at the same time. So for us the challenge is much bigger. Regional power interconnection will be one of the ways we can expand energy access and for a low-carbon transition… The number one barrier to low-carbon cooperation is finding financial and economic logic for regional cooperation. Unless both parties are on board nothing will happen."
- Yongping Zhai, Technical Advisor (Energy), Asian Development Bank

"It's very well to build out the picture of integration and regional cooperation but we also need the financing to get there. Building the energy infrastructure all has to be done at the same time as transitioning and improving energy access."
- Christine Kung-wai Loh, Undersecretary for Environment, Hong Kong SAR

"What is important is interconnection. Interconnecting our countries will bridge the gap for electrification"
- Simon D'ujanga, State Secretary for Energy, Uganda

15. La Russie et l'OPEP semblent converger pour coopérer et unir leurs efforts pour limiter la production de pétrole

"In the current economic backdrop, freezing or cutting oil production is the only way to sustainably retain it… Russia stands prepared to respond and it expects at the next OPEC meeting in November for an agreement to be reached."
- Vladimir Putin, President of the Russian Federation

"Freezing of [oil] production is the best way to rebalance the markets so we can all decrease the price volatility. It will help bring investment into the industry and it will influence the social and economic development of different countries. That's why we're prepared to join this freeze process."
- Alexander Novak, Minister of Energy, Russian Federation

"OPEC's mission is clear. We've always said that supply and demand is made up of two factors: market forces and reasonable coordinated action. We continue to believe in an important role for OPEC in coordinating discussions with other producers, just as central bankers meet to agree on easing money supply."
- Khalid Al Falih, Minister of Energy, Industry and Mineral Resources, Saudi Arabia

"This is not a question of the economies of oil producers, it's a question of the economy of the world…The world economy is waiting for a decision to be taken by the world's oil producers."
- Eulogio Del Pino, Minister of Petroleum, Venezuela

16. Les prix des matières premières continueront à être très volatiles, avec des cycles plus courts

"The stress on everybody's balance sheets has been huge and we're just not investing enough…If we don't invest, production will decline by around 5% per year, which is huge. There is huge oil-price volatility and not enough investment…The right strategy in the commodities business is to invest when prices are low."
- Patrick Pouyanné, Chairman and Chief Executive Officer, Total

"If the market weakness continues we think $1 trillion of investment will be delayed this decade. I'm concerned that if this happens I feel global oil supply will fall below demand. If it does it will have a major impact on prices."
- Amin Nasser, President & CEO, Saudi Aramco

"The real key to winning is to get into fundamentally advantageous resources. As long as you are in the low-cost barrels, you can survive in every price scenario."
- Maarten Wetselaar, Integrated Gas and New Energies Director, Royal Dutch Shell

"This industry is capital intensive and access to credit is a big challenge. To have three consecutive years of contraction in investment is a threat to the security of supply as well as consumption."
- Mohammad Barkindo, Secretary General, OPEC

17. Les ressources inexploitées en Asie centrale promettent toujours à la fois des opportunités et des défis exceptionnels

"Going forward, the liberalisation of electricity and gas markets must be our ultimate goal."
- Guler Sabanci, Chairman, Sabanci Holding

"The Tanap project is a huge investment but it's successful and we are cooperating with the Turkish government on this… We are also working directly with the EU on $10bn worth of projects, carrying gas to Europe and Turkey."
- Rovnag Ibrahim Abdullayev, President, SOCAR

"The Trans Anatolian Natural Gas Pipeline (Tanap) project with Azerbaijan will form the backbone of the South gas corridor. Turkey is in a good position from a geographic point of view in terms of offering the resources of the Caspian region and the Middle East to be transferred through Turkey. It has been working hard to turn these opportunities into projects."
- Binali Yıldırım, Prime Minister, Turkey

18. La digitalisation mène à des modèles d'affaires axés sur le consommateur

"Energy is the industry that has the biggest potential for digitalization. Digitalization in energy will create real outcomes for consumers by reducing losses in both transmission and distribution. It will eventually enable users to become producers. I believe it will the single biggest enabler in the energy sector's transformation towards 2060."
- Steve Bolze, President & CEO, GE Power

"Digitalisation is important in driving efficiency. Efficiency will come from connecting the resources, be it fossil or renewable resources, the existing assets and the customers and bringing them all together. This is what the world of digitalisation is really starting to open up. The area we talk about less is how can we better integrate all these technologies, grids and interconnections of people to master the challenges ahead?"
- Willi Meixner, CEO Power and Gas, Siemens

"The first driver of change is always technology, followed by customer desire, governments and regulators come after. Decisions must be localised and brought as close as possible to customers."
- Johannes Teyssen, Chairman and CEO, E.ON

19. Les pics de la demande attendus pour le charbon et le pétrole recentrent la discussion des « actifs échoués » sur les « ressources échouées »

"Hong Kong is setting a carbonless power market target. We are trying to decrease coal's effect on the power market from 50% to 25% by 2022. If we achieve our energy-saving target in 2020, we will need fewer coal power plants."
- Christine Kung-wai Loh, Undersecretary for the Environment, Hong Kong SAR

"There's no other way than phasing out coal. It is very clear it needs two-thirds less coal use by 2030 compared to 2010 in order to get to the EU's carbon emissions reduction targets. And that means about half of the coal plants in Europe will be shut down in the next 15 years."
- Patrick Graichen, Executive Director, Agora Energiewende

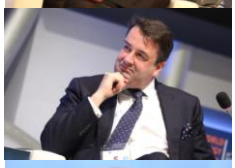
20. La « résilience faible » est nécessaire après une approche de « résilience forte »

"75% of supply in Brazil is based in hydro-power plants; 95% of the time generators will provide more than the assured level of energy. Power plants are located in different locations, each with different rain patterns, to diversify the risk. It is important to reduce the risk of power plant. Brazil is interconnected with Uruguay and Argentina, and in a few years South America will be completely interconnected…. We have to optimize not only the energy system but entire systems to be sustainable."
- Jose da Costa Carvalho Neto, former Chief Executive Officer, Eletrobras

"In Latin America, 54% of energy is generated by hydropower. Energy is strongly linked to water for the region, and we have all seen the impact of extreme weather during el-Niño. Regional integration will help our countries to mitigate the risks in the region… Latin America leans on bilateral agreements but we need more collaboration and greater integration of systems in the region. All of the major efforts in the last decade focused on access to energy, but the next step is to have more reliable systems and regionally integrated generation systems".
- Claudia Cronenbold, Bolivian Chamber of Hydrocarbons and Energy

21. La résilience des systèmes énergétiques fait face à de nouveaux risques comme les cyber-menaces, désormais enjeu majeur pour les entreprises

"There are two types of companies: ones that have been hacked and ones that don't know they've been hacked… I've seen increasing pressure on companies such as utilities to prove cyber security"
- O. H. Dean Oskvig, Vice Chair for North America, World Energy Council; President & CEO- retired, B&V Energy; Black & Veatch Corporation



"The more data points you have the more able you are to accurately predict that certain systems have certain vulnerabilities."
- Andrew George, Chairman, Energy Practice, Marsh

Everyone is rushing to adopt technologies but standards need to be used and best practices need to be implemented. It's important to make sure you have the expertise in-house and not farm it out to someone else. You need to understand it."
- Michael Bell, President, CEO and Member of the Board of Directors, Silver Spring Network

22. La demande mondiale pour l'énergie nucléaire devrait plus que doubler d'ici 2040

"The goal in Turkey is for nuclear to provide 10% of our total power generation by 2023, and a third nuclear plant project is on our agenda."
- Binali Yıldırım, Prime Minister, Turkey

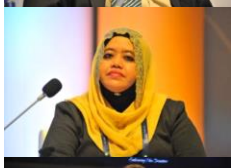
"It can be expected to see a huge success of nuclear energy in the very near future. It is possible to repeat the success of the previous century in the nuclear energy field."
- Kirill Komarov, First Deputy CEO, Rosatom

We need to gain public support for the future development of nuclear energy, especially in construction, operating and regulation issues. Countries could take advantage of proven designs which lead the way in terms of safety and efficiency to expand the peaceful use of nuclear energy.
- Jeff Benjamin, Senior Vice President, New Plants & Major Projects, Westinghouse Electric Company

"New construction is also at a 25-year high, with 65 rectors under construction with a capacity of 64GW."
- Agneta Rising, Director General, World Nuclear Association

23. L'ambition reste élevée pour la prochaine génération de biocarburants

"Over the past few years [in Nigeria] we have succeeded in convincing the government that biofuels production is needed. Our oil won't last more than 40 years and our gas won't last more than 60 years… From now there is going to be a more aggressive uptake of biofuels."
- Abubakar Sani Sambo, Advisor to the President of Nigeria



"The key success is the sustainability issue… Our [Jatropha] technology is a revolutionary breakthrough providing an earth to energy integrated solution made it a sustainable energy supply. That is the key success factor."
- Zurina Amnan, Chief Executive Officer, Bionas

"Everything starts with the climate change issue…Biofuels and biomass energy as a part of renewable industry will survive and will perform a great role in the energy mix."
- Remigijus Lapinskas, President, World Bioenergy Association

FUTURE ENERGY LEADERS' VISION FOR THE FUTURE DECLARATION

It is clear for all of us, Future Energy Leaders, that the energy industry is changing faster than ever. There are plenty and complex challenges in the energy sector to be solved under the Grand Transition.

We understand the world that is coming better than anyone. We live and breathe the world of fast pace information, communication and technology that will definitely impact your business and energy system.

This is why we will drive low carbon solutions. To embrace the new frontiers you require three key ingredients:

- Leadership
- Flexible business models
- Human capital

Taking the leadership

Solving of the challenges of our time is all about taking leadership. This is where the biggest opportunities exist. For companies, to take leading positions and change the industry.
For governments and policymakers, to create possibilities for the energy sector and citizens to contribute to the energy landscape.

The ability to take leadership will determine the winners and the losers for our future. It is imperative that organisations innovate otherwise they could wither and die. So let me call all the leaders and decision makers to recognise our voice, invite us to your board meetings and embrace a brighter future.

Adoption of flexible business models

Business as usual is no longer an option. We cannot solve the challenges with the current energy system. We, the Future Energy Leaders do not have all the solutions, but we understand which ones can best guide the whole energy sector towards a low-carbon future and energy access for all.

Today, and even more in the future, the digital world will affect the supply and demand dynamics in the sector. The new digital world will change patterns of consumption, optimizing assets in new ways, develop cross-industry partnerships and develop new industrial platforms.

Nonetheless, it is not all about technology. As energy markets become more complex, policies more fragmented, and customer behaviours evolve, innovation, entrepreneurship and flexible business models will be required to force existing players to re-examine the way they operate.

In the light of the global climate agreement, new policies will need to be put in place. Governments and policymakers must react faster. A higher degree of co-operation between policymakers, businesses and citizens will be needed to enable transparency and rapid technology adoption.

A new look to the human capital

We, the millennials, will be almost 50% of the global workforce by 2020, and we will certainly apply new approaches based on our values and our beliefs.

As customers, our generation's influence will grow over time. Companies will need to rethink their brands, business models and methods of marketing.

As professionals, we are ready to shape the energy future. In these challenging times the sector needs to attract the most skilled and enthusiastic workforce. Examples of the work already done such as the Council's Energy Academy and networks of national young energy professionals are inspirational. Organisations need to develop strong long-term strategies for talent management.

The energy sector is too male dominated and there is no chance of success if we waste our human resources. As stated by the FEL Human Capital report, inclusion and diversity in gender, age, ethnicity, religion, nationality and sexual orientation are critical to ensure organisation's ability to innovate and generate higher returns.

Being a forerunner might not always be easy. For sure, there is a risk of failure, but taking the leadership requires courage, knowledge and passion. This is what we, the Future Energy Leaders, are made of.

Les Future Energy Leaders à Istanbul

Jour 1

Vision et scénarios pour le futur

YOUNGHOON DAVID KIM SPEECH

Younghoon David Kim, Co-Chair; Chairman & CEO, World Energy Council; Daesung Group, South Korea opened the Presidential Address at the World Energy Congress with the following speech:

"On behalf of the World Energy Council I wholeheartedly welcome you to what is a very special moment in our 93-year history. You are joining us at the 23rd World Energy Congress to embrace the new frontiers of energy.

The World Energy Council is the largest global network of energy leaders from nearly 100 countries. We represent more than 3,000 organisations in the energy community, encompassing the private sector, academia and government and investors.
The Council is dedicated to delivering a reliable, sustainable, and affordable energy system for the greatest benefit to all.

The World Energy Council was conceived after World War I to demonstrate that energy could bring nations together rather than divide them. We thank you for your presence here today, which honors and reinforces our vision. Our special thanks should go to President Erodagan of the Republic of Turkey for his leadership and personal support in staging this significant event in Istanbul. I have no doubt it will be a great success.

Today we meet at a crucial time. The energy sector is undergoing a grand transition driven by the fast-paced development of disruptive new technologies and global environmental challenges.
Over the coming decades this profound energy transformation will fundamentally change the way in which we produce and consume energy.

Governments, industry, inventors and society as a whole are being called upon to respond to these increasingly complex challenges. Our industry has a historic opportunity to provide leadership to power the new industrial revolution.

In achieving our vision for a sustainable energy future, leadership at all levels will be critical.
Your presence and messages here today will help inspire the dialogue among energy leaders over the next three days.

Presidents, Prime Minister, Excellencies, distinguished guests ladies and gentlemen. Let us embrace the new frontiers of energy together.

Thank you very much."

PUTIN AND ERDOGAN: PEACE AND PROSPERITY THROUGH ENERGY COOPERATION

The Middle East region, home to 65% of global oil proven reserves and 45% of natural gas, is mired in conflict and greater energy cooperation could be a way of resolving entrenched disputes, global leaders and senior government officials said.

Recep Tayyip Erdogan, president of host nation, the Republic of Turkey, said that solving problems of scarcity and delivering supplies is a first step towards tackling the region's most troubling problems. "Unless we solve energy issues, we cannot solve any other issues," he said in his keynote address at the Congress.

The Turkish leader went on to highlight energy as a means to spread prosperity in the world. "Turkey's approach is not driven by natural resources or self-interest. We are committed to strengthening ties with central and northern Africa, based on humanitarian values and tenets," he said.

One of the overarching themes of the congress was echoed by Russian President Vladimir Putin. "Our common goal is to provide all the people of the world with access to modern energy resources. Today, there are 2 billion people in the world who don't have access to such resources," he said in his address.

The presidents of Russia and Turkey both touched upon their nations' continued energy cooperation, including talks on the proposed TurkStream natural gas pipeline. Russia is a main supplier of natural gas, crude oil and coal to Turkey and has agreed to build the Mediterranean nation's first nuclear power plant.

Other speakers at the opening ceremony were Turkish Prime Minister Binali Yildirim, Turkey's Minister of Energy, Berat Albayrak, President of the Turkish Republic of Northern Cyprus Mustafa Akinci,Azerbaijan's President Ilham Aliyev, and President of Venezuela Nicolas Maduro.

THE AGE OF HYDROCARBONS IS FAR FROM OVER

While the world must focus on decarbonising its energy sector, conventional fossil fuels will continue to be essential to eliminating energy poverty, Russia's President Vladimir Putin told.

"Against the backdrop of challenging economic times this is a good opportunity for discussions around how to sustainably supply energy. Our common goal is to provide energy access to as many people as possible," Putin said. "There are still around two billion people in the world with no access to electricity, light and heat."

Putin's message was at odds with one of the key themes of the conference: the urgent need to meet global rises in energy demand while simultaneously decarbonising the energy sector.

"Some people say that since the price slump we should completely redirect energy to cleaner sources. I believe there are no grounds for such far-reaching conclusions," he said.

"So-called smart grids have helped to speed up the process [of increasing energy access] but at the same time oil and gas consumption is speeding up. India and China's consumption continue to increase," Putin added. "But there is also [strong demand from] industrial products and the growth of the liquefied natural gas market. For the first time volumes of LNG will surpass conventional gas deliveries."

The price slump that began in mid-2014 was partly caused by Opec's decision to retain its strategy of pumping at will until it provisionally agreed in September in Algiers to maintain oil production at between 32.5m b/d and 33m b/d. The organisation is due to continue discussions and potentially formalise the agreement at its next official meeting in Vienna in November.

In August the group's oil output was 33.47m b/d, according to the International Energy Agency (IEA). That's around 0.93m b/d higher than a year earlier.
Reaching a group-wide agreement — which all members adhere to— will be crucial for maintaining the longevity of global crude production, Putin told the Congress.

"In the current economic backdrop freezing or cutting oil production is the only way to sustainably retain it," he said. "Russia stands prepared to respond and it expects at the next Opec meeting in November for an agreement to be reached."

Iran may again prove to be a sticking point. The Islamic republic wants to add another 100,000-150,000 b/d in the short term, as new production from the West Karun fields comes online. And it still wants to reach 4m b/d, implying growth of more than 350,000 b/d.

In early October the IEA downgraded its global oil demand growth forecast for this year by 100,000 b/d, adding that sluggish macroeconomic growth was keeping the market from returning to balance. The IEA now expects global oil demand to grow by 1.3m b/d this year. Next year it expects growth to slow again to just 1.2m b/d.

A TIME OF CONVERGENCE AND COLLABORATION

Secretary-General Mohammad Barkindo, joined onstage by SOCAR President Rovnag Ibrahim Abdullayev, spoke of seeing a "convergence of views between net producers and net consuming countries." Consuming countries, he said, were showing equal concern with the current period of low oil prices as their producing counterparts.

Barkindo and Abdullayev spoke on key issues affecting the global energy industry. Abdullayev discussed Azerbaijan's approach to the prolonged period of low oil prices, saying that while many countries halted investments, Baku has implemented a different strategy.

"We decided to undertake large projects. We didn't look at it only from a commercial point of view. With projects such as Shah Deniz, we wanted to provide long-term energy security," Abdullayev said. He called large-scale investments in the current environment, such as in the TANAP pipeline, "difficult," but emphasised their value.

Barkindo stressed the unexpected longevity of the slump in prices. "We've had this severe contraction in investments and next year, it's still looking bleak." In light of the drop in upstream investments, he said, this "poses a serious threat" to the security of the supply.

He also brought up the issue of energy poverty, noting that 2.7 billion people rely on biomass, while another 1.5 billion live without access to electricity. Downplaying recurring predictions of peak oil, he emphasised that demand for energy would continue to grow.

Talking of the COP21 summit on climate change, he praised the collaborative spirit at the meeting. "The world has spoken with one voice in Paris and OPEC and its member countries have participated actively," he said.

"The Algiers Accord was a demonstration of the commitment of all OPEC member countries to the ideals of the organisation," he said.

"We have seen this commitment through war and through peace. Stability and sustainability has always been our watchword and our objectives in all our conduct," he added. "Regional tendencies and polarisations have sometimes been overexaggerated."

News release based on the Presidents Special Address: reactions from Energy Leaders

DIGITISATION AND EFFICIENCY ARE KEYS TO OUR ENERGY FUTURE

Digitisation will be the single most important tool for addressing the challenges that lie ahead for the energy industry. Leading executives laid out their visions for tackling key obstacles to developing a clean, diversified energy industry in the opening panel of the Congress.

The discussion, introduced by Gerald Davis, Executive Chair of World Energy Scenarios at the World Energy Council, and led by CNN's John Defterios, saw participation by top executives from global energy companies including Engie, IEA, WWF, GE, Siemens and Koc Holding.

Panelists offered insights on potential directions for the energy industry. At issue are three key goals: achieving the COP 21 targets from the 2015 Paris Agreement on climate change, pursuing and deploying technological breakthroughs and digital transformation of the industry.

Fatih Birol, Executive Director of the International Energy Agency, stressed efficiency as key to meeting rising demand, comparing it to an untapped fuel: "All countries have energy efficiency resources. Unfortunately we are not making enough use of this." He pointed to slowed growth in China's oil demand as an example of steps made due to increases in efficiency.

Steve Bolze, CEO and President of GE, underlined the huge opportunity offered by utilising big data effectively, "Energy is the industry that has the greatest potential for digitisation. Digitisation is the single biggest enabler in the energy sector's transition towards 2060. We're currently just scratching the surface."

For the required transformation to take place, according to Engie's CEO Isabelle Kocher, industry players would have to cope with decreases in the cost of electricity. "We have to reinvent not only our technologies and structures, but even the way we create value," she said. Kocher said change in the market was due to a bottleneck, not caused by a lack of finance or technology, but by a lack of convergence in public regulations. Convergence, she stressed, must be global.

Regine Günther, Climate and Energy Practice Leader, World Wildlife Fund, asked who should lead the global transition to a cleaner and more diversified energy economy. Her answer was those responsible for the greatest contributions to global carbon output, namely OECD nations.

Willi Meixner, CEO, Power and Gas, Siemens, laid out a vision for promoting energy efficiency through digital technologies. "Efficiency will come from really connecting the resources, the existing assets, and the customers – this is what the world of digitalisation is starting to open up."

Gerald Davis, Executive Chair of Scenarios, World Energy Council, said, "The world is undergoing a grand transition, which will create a fundamentally new world for the energy industry," adding, "historically, people have talked about peak oil but now disruptive trends are leading energy experts to consider the implications of peak demand."

"Limiting global warmsing to no more than a 2°C increase will require an exceptional and enduring effort," Davis warned. "The phenomenal rise of solar and wind energy continues. Learning curves will lead to continuous price reductions."

News release based on the session Scenarios 2060: the Grand Transition

CONSUMERS WILL DRIVE THE TRANSITION TO SMART GRIDS

Electricity grids need a new model, one that puts power in the hands of consumers. A panel discussing smart electricity transmission grids emphasised the importance of two driving forces behind their widescale implementation: data and consumers.

With its potential to promote efficiency and transform the way companies and consumers interact with electricity, data was highlighted as a central benefit of the smart grid. Electrical grids collect huge amounts of data, which is frequently lost to both utilities and consumers.

But while consumers will be key in the transition to smart grids, bringing them on board with the change may not be easy.

Julian Hardy, CEO, Eseye, said, "Consumers have an apathy to data. They focus on cost, on environmental footprint and access to energy in emerging markets." "Whoever controls the presentation of this data as a tool will have a major impact on its uptake," he added. Consumer access to this data could mean smarter power choices about which method to use for residential heating and when to charge electric cars.

Panelists stressed the importance of the security of the system. With Hardy saying, "At the end of the day, you're dealing with consumers' lives."

Leonhard Birnbaum, Member of the Board of Management, E.ON, and Vice Chair for Europe, World Energy Council, concurred: "The stakes are very high."

"We need to manage this transition," Birnbaum said. "[The grid] is the basis of the wealth of our society. If it breaks down, we cannot recover."

Panelists agreed that consumers will be the key factor in bringing about the transition to smart grids, once they see their benefits. "I very much believe in the power of the prosumer. If you can make a case for smart grids to the prosumer, there will be a drive for change, TTTech's Georg Kopetz said. "We will have a bright future if we can manage to get the consumer as the driving force for this change."

A smart grid is the incorporation of internet technology into electric power infrastructure. An important component of the smart grid is the use of smart meters, which consumers and utilities can use to track electricity usage and predict demand, resulting in increased efficiency.

The digitalisation of the electricity grid also holds potential for the greater integration of renewable forms of energy, such as wind and solar power. Where previously the addition of renewables would have had to be synchronised with the sources of the grid to avoid voltaic fluctuations, the smart grid allows the energy to be added at transmission and distribution levels and stored until needed.

Smart grids smaller sub-stations rather than a single large power plant, meaning the system is less at risk for fall out from natural disasters. When there is a problem, sensors can isolate the problematic line and re-route the power. In order to mitigate overloads, the system can recognise peak load problems and divert power as necessary to prevent outages.

Smart grid technology is being employed in countries such as China, India, Brazil, and Turkey as they seek to increase their energy efficiency.

News release based on the session Smart Grids update: engaging the prosumer

NUCLEAR POWER HAS A ROLE IN MITIGATING CLIMATE CHANGE BUT AT A COST

Nuclear power generation could help limit the global temperature rise to below 1.5°C - significantly lower than the target of 2 degrees set by the Paris Agreement. But its future is in the balance. Countries are divided between those in favour and those that see it as too risky or expensive.

The development of nuclear power today is concentrated with a small group of nations. China, India, Korea and Russia accounted for 40 of the 65 reactors under construction at the end of 2015. There are 446 operating nuclear reactors globally, which produce 11% of the world's electricity.

Obstacles to more widespread nuclear power are public opposition, especially after the Fukushima reactor accident in 2011, the increasing price tag of reactor construction, and the falling costs of gas feedstock and renewables technology.Countries looking to reduce nuclear power in their energy mix include Germany, which plans to close all its plants by 2023, and the USA, which has closed four reactors in the past few years with more on the way.

Meanwhile, the UK is in the planning stages of building Hinkley Point C, estimated to be the world's most expensive nuclear reactor to date, at USD 24 billion, and is considering two more plants elsewhere. China is looking to quadruple nuclear capacity by 2020 and India plans to have 25% of its energy capacity met by nuclear reactors by 2050.
Meanwhile, technological development continues in areas such as fast neutron reactors, hightemperature reactors, and small modular reactors.

Wang Binghua, Chairman, China's State Power Investment Corporation, said, "Nuclear power has no frontiers. The security of a nuclear plant has no frontiers either. Any country that intends to develop nuclear energy needs to manage security problems and must consider other [countries]." Wang underlined that finding the correct design and location for nuclear energy facilities should be a nation's top priority.

Kirill Komarov, First Deputy CEO for Corporate Development and International Business, Rosatom, was confident in the future success of nuclear energy. "It is possible to repeat the success of the previous century in the field of nuclear energy."

Jeff Benjamin, Senior Vice President for New Plants and Major Projects, Westinghouse Electric Company, outlined the necessity of gaining public support for future nuclear energy projects, especially in their construction, operation and regulation. He said a major priority for the industry should be a focus on the proper design of facilities in terms of safety and efficiency.

Lauri Virkkunen, President and CEO, Pohjolan Voima, and Chairman, Finland Member Committee, World Energy Council, suggested that although nuclear waste was a clear challenge, Finnish and Swedish companies have been working to solve the issue.
Virkkunen also highlighted Finland's decision to pursue nuclear energy.
"Hydro sources are not enough to produce the required electricity. The decision to use nuclear power was taken because of this reality." He pointed to a 2015 survey that showed that around half of Finnish people were positive about using nuclear energy.

Naohiro Masuda, Chief Decommissioning Officer, TEPCO, addressed concerns about the aftermath of Fukushima. "We focused on efforts to fix safety problems after the Fukushima nuclear disaster in 2011. We have successfully followed security protocols and contamination has been significantly reduced."
Qin Sun, Chairman, China National Nuclear Corporation, "Nuclear accidents happen because of human faults. Therefore we have to focus on a human centered approach."

News release based on the session Tomorrow's nuclear and today's realities

MORE INDUSTRY INCENTIVES NEEDED TO FURTHER DEVELOP CCS TECHNOLOGY

Carbon capture and storage has an essential role to play in reaching global emissions reduction targets, despite slow development. For the session's participants, the main obstacles to capacity expansion are financial, regulatory and public opinion.

CCS projects are often small, with capacity less than 1 million tonnes of CO_2. There are 22 large-scale CCS projects currently in operation or under construction around the world, with capacity to capture up to 40 million tonnes of carbon dioxide per year. These projects cover a range of industries including gas processing, power generation, fertilisers, steel, hydrogen production and chemicals. Cement, chemicals, iron, refining and steel plants contribute to 20% of global carbon emissions.

While optimism about CCS was strong in the early 2000s, deployment has been slower than anticipated. Recent innovation breakthroughs, such as mineralisation, fuel hope for a fresh start. The World Energy Council's energy scenario expects the technology to play an important role in emissions mitigation after 2030. Meanwhile, the IEA estimates CCS will contribute to about a sixth of total CO_2 emissions reduction required in 2050 and 14% of cumulative emissions reduction through 2050, against a business-as-usual scenario. Amit

Kumar, Dean (Distance & Short Term Education) of the Energy and Resources Institute of India highlighted the main problems faced by CCS technology, citing his home country as an example. The electricity generation sector accounts for about 40% of India's CO_2 emissions. He said: "The high cost and energy intensiveness of CCS projects have a direct effect on the volumes of electricity that can be produced and electricity prices." Electricity shortages in rural areas mean investment is channeled towards new power plants rather than towards CSS technology.

Christian Friis Bach, Executive Secretary of the United Nations Economic Commission for Europe (UNECE) emphasised the need to develop more large-scale plants at the global level. Bach underlined the importance for governments to create incentives for the private sector to develop such projects. He added that the UN in general can provide space for dialogue on CSS projects and issues. On the COP21 Paris Agreement, Bach said that it was, "nowhere near enough and it should not become an excuse not to try to go further."

John Scott, Chief Risk Officer, Zurich Global Corporate agreed that CCS has an extensive role to play in reducing emissions but that many barriers exist and have led to slow development, even though the technology has long been available. He insisted on the lack of financial incentives and the inadequacy of existing regulations in European countries who, "Although well-intentioned, have developed strict directives and regulatory frameworks, making such projects impossible in Europe." He added: "Technology in general has a key role to play in decarbonising our economies, and CCS is just another component."

Hildigunnur Thorsteinsson, Senior Vice President at Reykjavík Energy concluded the discussion by highlighting the benefits of mineralisation – dissolving CO_2 in water before injecting it in rocks. He said: "It is a very safe storage method that requires a minimum of monitoring. Before we ran this project, most thought mineralisation would take 100-1000 years but 95% of the CO_2 is actually mineralised within two years. CCS costs $60-100 per tonne of CO_2 captured and stored but capture is the expensive part. The cost of storing is much lower."

News release based on the session "Decarbonising the future: the role of CCS"

ENERGY TRANSITIONS AND POWER SECTOR UNBUNDLING 2.0

Perhaps the world's most widely used commodity is not really a commodity after all. Perhaps the combination of electricity's attributes only look and feel like a commodity because that is how it has been delivered for so long. The increasing penetration of small-scale distributed energy resources aim to be a catalyst for decommoditising electricity, redefining the value chain horizontally, rather than the conventional paradigm of a unidimensional, vertical industry.

This could allow new and existing players to create products and services that consumers neither knew they could buy nor even that they were already buying. It could establish more efficient pricing mechanisms and monetise services that customers thought they were receiving free-of-charge. Experience in other sectors suggests that the fragmentation of an industry need not lead to ballooning costs.

However, electricity may not be immune from the 'sharing economy'. The focus of much debate about distributed energy technologies (mostly solar panels) is the costs they impose on the system that are 'socialised' by the utility—admiration of my neighbour's new roof may turn to resentment when I discover that I am helping pay for it. Talk of a 'utility death spiral', as consumers unplug from the grid, leaving a smaller base to share the integration costs, is overdone, but reflects the tone of transitions in which new entrants gain their toehold as free-riders on the incumbents.

These new technologies make it clearer that electricity has multiple attributes, each potentially valued differently by consumers. The most straightforward dimension is 'energy'—the change in the meter reading at each billing cycle. But consumers are beginning to look past the 'electricity' and focus on the 'reason' or service, such as recharging a battery or watching TV. They may do this without noticing because appliances are becoming smarter—they may not care exactly when their cooling and heating systems are running, only the temperature and air quality they experience.

Other intangibles include the value of emissions avoided or even the value of non-consumption (sometimes referred to as Negawatts), which consumers may be able to sell to others.

We are on the verge of Unbundling 2.0. This builds on the disaggregation of the vertical value chain of generation, transmission, distribution and retailing in the late twentieth century that was Unbundling 1.0. Now we are focusing on the horizontal elements, separating out energy, reliability, rate of change, time of use, emissions and conservation. Future electricity business models may borrow elements from companies that operate in the sharing economy.

The value proposition is to use the internet to bring together people with underused assets, and those that might like to make use of them. As information from both parties becomes more transparent, another possibility is to rent them with low transaction costs through platform providers.

The new role of utilities may be as system integrator and platform provider. Just as internet banking turned out to be the tip of the iceberg for fintech, so it might be for electric power. The distribution operator business may transcend pure asset management to become a platform on which new entrants can provide products and services via their own two-side markets, including home management systems, demand response and electric vehicle platforms.

Regulators must create functional markets which can handle unbundled services, prevent technological lock-in and protect the vulnerable by staying abreast of innovations— all the while, preventing discrimination in the operation of these platforms favouring one provider over another.

ECONOMIC AND ENERGY TRANSFORMATION THROUGH DECARBONISATION

Hoesung Lee, Chair, IPCC

Nations came together in Paris to keep global warming below two degrees Celsius above pre-industrial levels, while pursuing efforts to limit it to 1.5 degrees Celsius.
That target, building on one previously agreed by governments, is based on the scientific assessment of the IPCC.

Countries that ratify the Paris Agreement will submit Nationally Determined Commitments (NDCs) to reduce their greenhouse gas emissions. Each country's compliance with its commitments will be publicly reported and internationally reviewed. Beginning in 2018, and every five years thereafter, there will be a stocktake to assess progress, and after each new round of stocktaking countries will be expected to submit more ambitious NDCs.

As the chair of the Intergovernmental Panel on Climate Change (IPCC), I am pleased and proud that the Climate Panel will make a significant contribution to the implementation of the Paris Agreement.

We are now preparing a report on the feasibility of holding global warming to 1.5 degrees Celsius. That report will be delivered in 2018, when governments first take stock of their progress in meeting the goal.

The *Synthesis Report* for the IPCC's Sixth Assessment of the scientific literature, related to climate change, will be published in 2022, in time for the 2023 stocktake. Finally, the Climate Panel is studying how best to structure its assessment work so that countries have the scientific information they need for each stocktake every five years after 2022.

Learning from history

It is worth recalling the findings of the IPCC's last comprehensive survey, *the Fifth Assessment Report*, completed in 2014, where the focus was more on two degrees Celsius and above.
The Climate Panel concluded:

- Human activity is disrupting our climate;
- The more we disrupt our climate the more we risk severe, pervasive and irreversible impacts;
- We can make the choice to limit climate change and build a more vibrant and prosperous
- world.
- The *Fifth Assessment Report* shows that the world faces a considerable challenge
- to meet even the upper limits of the Paris Agreement goal—global emissions must peak as soon as possible and be reduced to zero during the last half of the century.
- Stabilising the climate in this way will require a number of directives, including:
- Complete decarbonisation of electricity production;
- Transport powered by decarbonised electricity or hydrogen;
- Sustainable cities with low-carbon high-efficiency infrastructure.

Making progress

Decarbonisation of electricity production is developing quickly thanks to efficiency improvements and cost reductions for renewables.

When I started my career, demand for electricity was growing almost twice as fast as GDP—now it is growing at less than the rate of GDP in industrialised countries. Improvements in the efficiency of lighting, appliances and equipment have been enormous and continue apace.

The reductions in the costs of renewable energy technologies have also been astounding. Wind and solar are cost-competitive with fossil-fuel generation in many areas and their costs continue to decline.

Renewables accounted for over half of all new generation capacity globally in 2015.
Of course, they are intermittent sources, so increased reliance on wind and solar will require—for the time being—natural gas generation plants that can be ramped up and down quickly.
In the longer term more storage will be needed, and as storage technologies improve costs will decline.

So far the impacts have been most severe for coal – the most emissions intensive fossil fuel. Coal-fired generation is declining globally, leading to a precipitous decline in world coal prices and bankruptcy of several large coal producers.

The process of weaning the transport sector off fossil fuels is not as advanced, but signs of progress are evident. Global gasoline demand is growing by less than 1.5% per year and declining in industrialised countries driven by fuel efficiency standards. Continuing improvements in fuel efficiency are facilitating the transition to electric, fuel cell and hydrogen vehicles while reducing greenhouse gas emissions.

Alternative technologies have been on the market for two decades and are gaining increasing acceptance.

One of the biggest challenges for policymakers, in developing countries and multilateral development bodies, is to avoid locking in high-carbon infrastructure. Our ability to reduce greenhouse gas emissions by 40-70%, by 2050, will be determined by the investment decisions we take today.

Building new coal-fired power plants, as some countries are considering, will make it very difficult to keep warming below two degrees Celsius this century.

Just carrying on as we have done would not be business as usual, because global business activity would be transformed for the worse by the impacts of unrestrained climate change.

Conversely, decarbonising our economy will bring other benefits in terms of sustainability, while opening new economic opportunities through new technologies.

WIND TO MUSCLE IN ON HYDROPOWER MARKET SHARE

Hydropower has dominated the landscape of renewable energy production globally but production from other sources of clean energy will soar over the next two decades, as the fuels become more cost competitive.

The share of renewables used for electricity generation globally will rise, from 22% of the 5,105 terawatt hours (Twh) generated in 2013 to 34% of the 13,429 Twh which will be produced in 2040, according to the International Energy Agency (IEA).

While hydropower is expected to remain the dominant renewable energy source for power generation over the next two decades production of wind power will soar, taking a slice of its renewable rival's market share.

In 2013 hydropower generated 3,789 TWh of electricity—almost three quarters of a total 5,105 TWh generated, according to the IEA.

By 2040 hydropower is expected to generate 6,180 TWh of electricity—according to the IEA's New Policies scenario—which assumes cautious implementation of proposed government policies in addition to existing measures. But its share of the total renewables used for electricity generation globally will fall, to 46% down from 73% in 2013, of the 13,429 TWh generated.

Full force

Meanwhile wind power's share of total global electricity generation will rise, from just 12% in 2013, to 27% in 2040.
Between 2013 and 2040 total wind power used for electricity generation is expected to rise from 635 Twh to 3568 Twh.

The IEA expects electricity generated from all renewable energy sources to skyrocket by between 125% and 250% from 2013 to 2040 as costs will continue to fall. Nearly three-quarters of renewable power generation—mainly hydropower— is now cost competitive without subsidies.

By 2040 the share of non-hydropower renewable energy which is cost competitive without subsidies will double to one-third, the IEA said. However subsidies for renewables-based power generation will rise from $112bn in 2014 to $172bn in 2040.

The use of renewable energy to meet total primary energy demand will soar by over 1.5bn tonnes of oil equivalent by 2040—a rise of 80% from 2013 levels. However the share of renewables in global total primary energy demand is expected to remain at around 15% between now and 2040 because of the projected rise in global energy needs.

Low-carbon energy—including renewables, nuclear power and carbon capture and storage—could collectively meet 46% of primary energy demand by 2040, according to the IEA.

Whether this happens will depend on the level of government support available and investment levels.

Last year investment in new renewables power capacity fell by $5bn, to $288bn, according to the IEA.

Total investment in renewables, including biofuels for transport and solar thermal heating installations, amounted to nearly $315bn.

However because costs have fallen, last year's $288bn investment level resulted in nearly 40% more capacity, compared to 2011, and will generate one-third more electricity.But IEA director Fatih Birol warned that investment in renewable energy will need to triple to meet carbon reduction targets agreed at last year's Paris climate talks.

SCÉNARIOS ÉNERGÉTIQUES MONDIAUX
LA GRANDE TRANSITION

The report 'World Energy Scenarios 2016: THE GRAND TRANSITION' presents three exploratory scenarios —Modern Jazz, Unfinished Symphony, and Hard Rock. These provide users with a common language for thinking and talking about current events. They provide energy leaders with an open, transparent, and inclusive framework to think about a very uncertain future, and thus assist in the shaping of the choices they make.

The study has developed three realistic scenario stories using an explorative approach rather than the more commonly used normative, methodology:

The three scenarios developed are Modern Jazz, which represents a 'digitally disrupted,' innovative, and market-driven world, Unfinished Symphony, a world in which more 'intelligent' and sustainable economic growth models emerge as the world drives to a low carbon future, and a more fragmented scenario called Hard Rock, which explores the consequences of weaker and unsustainable economic growth with inward-looking policies.

World Energy Scenarios 2016 were built in collaboration with Accenture Strategy and Paul Scherrer Institute (PSI) and a network of more than 70 members, from over 25 countries, and quantified with a global multi-regional energy system model. Feedback was also gathered at the Council's Energy Leaders' Dialogues and at 14 workshops around the world, ensuring the inclusion of key insights from leaders of the industry, politics, economics, environment, technology, and science.

Le rapport « Scénarios énergétiques mondiaux 2016 : LA GRANDE TRANSITION » présente trois scénarios exploratoires : Jazz moderne, Symphonie inachevée et Hard Rock. Ceux-ci fournissent aux utilisateurs un langage commun pour penser et parler des événements actuels. Ils fournissent aux dirigeants de l'énergie un cadre ouvert, transparent et inclusif pour réfléchir à un avenir très incertain et ainsi aider à façonner les choix qu'ils font.

L'étude a développé trois versions de scénarios réalistes en utilisant une approche exploratoire plutôt que la méthodologie normative plus couramment utilisée :

Les trois scénarios développés sont *Jazz moderne*, qui représente un monde « perturbé par le numérique », innovateur et axé sur le marché, *Symphonie inachevée*, un monde où les modèles de croissance économique plus « intelligents » et durables émergent alors que le monde conduit à un avenir bas carbone, et un scénario plus fragmenté appelé *Hard Rock*, qui explore les conséquences d'une croissance économique plus faible et non durable avec des politiques tournées vers l'intérieur.

Les scénarios énergétiques mondiaux 2016 ont été élaborés en collaboration avec la Stratégie Accenture et l'Institut Paul Scherrer (ISP) et un réseau de plus de 70 membres issus de plus de 25 pays et quantifiés avec un modèle multirégional d'énergie. Les commentaires ont également été recueillis lors de plusieurs *Energy Leaders' Dialogues* organisés par le Conseil Mondial de l'Énergie et dans 14 ateliers à travers le monde, ce qui a permis d'inclure les principaux points de vue des dirigeants de l'industrie, de la politique, de l'économie, de l'environnement, de la technologie et de la science.

Synthèse et rapport disponibles sur : http://wec-france.org/etudes.php

TRIBUNE D'OLIVIER APPERT

PRÉSIDENT DU CONSEIL FRANÇAIS DE L'ÉNERGIE

Le Congrès d'Istanbul a été de qualité avec des intervenants de haut niveau. Le Conseil Mondial de l'Énergie conserve à l'évidence un *conveening power* important. L'ambiance était cependant un peu morose. Cela était clairement dû au contexte sécuritaire en Turquie mais aussi au contexte sur le marché du pétrole et du gaz et à la situation difficile de nombreuses utilités. Concernant les participants, on peut regretter une faible participation des chinois, des asiatiques en général, mais aussi des américains.

Le pétrole et le gaz ont pleinement leur place maintenant au sein du Congrès. L'actualité sur le marché pétrolier a permis de traiter des sujets chauds sur la scène énergétique : cela a été une opportunité pour « écrire l'histoire ». Cependant, personne n'a parlé de l'éléphant qui était dans la salle : le charbon. On a fait semblant de croire que le charbon allait disparaître très bientôt et il est significatif qu'aucun intervenant n'ait abordé sérieusement le problème du charbon : il aurait été utile d'entendre un charbonnier chinois ou indien. Cela nous aurait ramenés aux dures réalités du secteur de l'énergie.

Je reste sur ma faim sur certaines sessions : trop d'intervenants dont certains n'ont pas grand-chose à dire, on survole les sujets. Heureusement les animateurs sont de qualité, ce qui rachète les sessions. Le format des sessions est toujours le même. Une diversité de forme serait souhaitable pour donner du rythme.

Le Congrès est une échéance importante pour le Conseil Mondial de l'Énergie et la communauté énergétique dans la mesure où sont finalisés pour cette occasion des rapports qui ont mobilisé de nombreux acteurs du Conseil Mondial de l'Énergie pendant de longs mois. Il est regrettable qu'aucun de ces rapports n'ait été présenté lors du Congrès, à l'exception des scénarios. Ce serait pourtant une occasion de mobiliser les membres du Conseil Mondial de l'Énergie et de faire passer les principaux messages devant une audience élargie.

Au cours des sessions, on reste très politiquement correct. Trop rares sont les interventions qui sortent du moule et pourraient faire réfléchir. Certes, il ne faut pas transformer les plénières en pugilat, mais on pourrait avoir plus de débat. Cela suppose de limiter le nombre d'intervenants et de favoriser les échanges entre panélistes.

On a pris conscience lors du Congrès que le problème du transport est important. Mais on ne sait pas bien quoi faire : donc on se précipite sans réfléchir sur le véhicule électrique qui est considéré comme la silver *bullet*. En ce sens, la session consacrée au stockage et au transport a été caractéristique : comment traiter en 90 minutes des sujets aussi importants et multidimensionnels que le stockage de l'électricité et le transport ? On est tombé dans tous les poncifs. Heureusement, un chercheur académique nous a réveillés, à la fin, en soulignant la complexité des problèmes qui ne se résolvent pas à coup de slogans et de pubs.

Tout le monde est pour la transition énergétique. Mais combien cela coûte-t-il ? Quel est le bilan coûts / avantages réel des diverses solutions ? Il est significatif que personne n'ait fait allusion aux approches d'analyse du cycle de vie ou aux *business models* à mettre en place. Il est vrai que, pour beaucoup, la technologie peut tout et il suffit d'une volonté politique pour mettre en œuvre ces solutions, avec le paquet de subventions qu'il faut. Quand on aime, on ne compte pas…!

La formation était absente. C'est dommage car la transition énergétique se fera avec les jeunes en cours de formation.

Autres tribunes à lire : Jean-Marie Dauger (page 54) et Bruno Lescoeur (page 66)

Jour 2

Identifier les opportunités commerciales : ressources et technologies

URBAN ENERGY IN THE AGE OF THE MEGACITY

As the world's population urbanises—66% of people are expected to live in cities by 2050—we are entering the age of the megacity. So how can nations ensure that burgeoning cities have the energy they need to prosper?
It's an issue Arup examines closely in its Urban Energy Report, released at the 23rd World Energy Congress.

"Cities account for over half of global energy consumption and for 40% of greenhouse gas emissions," explains Ian Gardner, global energy leader at Arup. "So the question of how energy can contribute to the success of cities is becoming increasingly urgent. Reducing the impact of urbanisation by increasing urban energy-efficiency and switching to clean, low-carbon resources is critical."
The Arup report begins by exploring the unique challenges of dense urban areas.

"While the density of cities can make energy-efficient infrastructure cheaper, it can also limit renewable resources such as solar and wind," Gardner explains.
"The sheer pace of urbanisation can be hard for cities to keep up with—particularly given their legacies of urban form, buildings and infrastructure. This means that governance is another major challenge."

So how can cities address such wide-ranging challenges?
"It's my belief—and the basis of the report— that a paradigm shift is needed to meet cities' needs with low-carbon energy," says Gardner. "We need an approach that integrates different energy vectors—different forms of carrying energy from the point of generation to the point of use—and controls them as a single system."

Electricity grids. Gas networks repurposed to carry hydrogen. District heating. Transport fuel. Ground source or air source heat pumps. Arup's report argues they all need to be part of a mix that's controlled smartly.

Efficiency drive

Achieving this, Gardner and his colleagues assert, requires a system of economic and control mechanisms that allows much more dynamic balance of supply and demand across a city. This concept, which the report's authors describe as "transactive energy", uses data and technology to radically transform the overall efficiency of this integrated system.

Cities are already joining forces, says Gardner. "Many major cities and their mayors are realising they can create city action networks, with firms like Arup advising on how they can structure policies to benefit from an integrated approach. For example, the 700 signatories of the Mayors' Declaration on Renewable Energy have pledged to move to 100% renewable energy in their cities by 2050."
But typically renewable energy comes in the form of electrical power so this places challenges on the electricity network.

Energy can't, of course, be considered in isolation and Arup's report calls for urban energy and the built environment to be considered as an integrated whole. Gardner points to the cities of Atlanta in the US and Barcelona in Spain as examples.
Both are home to roughly five million people, yet Atlanta's carbon and energy footprints for transport are ten times that of Barcelona's because of its urban sprawl.

The Urban Energyreport also includes a new vision for hydrogen as an important component of this integrated approach. As well as suggesting injecting hydrogen into the gas grid, it advocates the use of hydrogen for energy storage, combined heat and power, and as a fuel for buses and commercial vehicles. The authors point to examples that include the Japanese government's aim of deploying 1.4 million fuel cells for home energy storage by 2020 – and 5.3 million by 2030.

Utilising potential

In many cities, taking advantage of hydrogen's potential will require a change in regulatory thinking. "When you consider London's gas network carries five times more energy than its electricity grid, doesn't it make sense for the city to use this grid in new ways?" asks Gardner.

"The problem is that regulations in the UK currently prevent this. With its legacy of steel gas mains, the UK has so far restricted putting hydrogen into the pipes because it can make them brittle.
But where the old pipes have been replaced with plastic ones, there's no reason this restriction shouldn't be lifted."
Even with a shift in regulatory thinking, a radical new approach to urban energy will need financing.

New models

Despite the challenges this poses, many cities are already using new financing models such as energy performance contracting. This uses the financial savings from energy conservation measures to fund the cost of those measures.

"In our Urban Energy report, we look at cities that are leading this thinking, with some even setting up their own integrated municipal energy companies," explains Gardner.

"For example, Munich's municipal energy company already generates enough renewable energy to supply all the city's private households, subways and trams. If more cities follow this lead, I'm hopeful that a global transformation in the relationship between cities and energy will gather momentum."

HEAD OF SAUDI ARAMCO CALLS FOR ENERGY 2.0

Navigating the transition from fossil fuels to a sustainable energy supply model will require a new road map, said Amin Nasser, President and CEO of Saudi Aramco, during his keynote speech at the 23rd World Energy Congress.

"Incremental improvements will not be enough. We need transformational improvements," Nasser said, calling the new road map "Energy 2.0."

The transformation is discussed in a report by the World Energy Council, prepared in collaboration with Accenture Strategy and the Paul Scherrer Institute, called "World Energy Scenarios", which outlines the need for new policies, strategies and investments, which carry risks.

"New discoveries are more challenging and more expensive to develop. Fields are increasingly mature and difficult to operate," Nasser said. Pointing to almost USD 1 trillion in cancelled or deferred development projects, the Saudi Aramco chief said that the global oil supply growth "risks falling behind demand over time," which would have a grave impact on the world's economy.

Talking about the road map for the current transitional period, Nasser highlighted three key components for business: to continue adequate and timely investment in the supply of oil and gas, maintaining strong financial capacity and resilience and sufficient investment in innovation and technology.

Nasser also touched upon Saudi Arabia's Vision 2030, saying Saudi Aramco was studying downstream opportunities in Turkey as part of the Kingdom's diversification plans. Additionally, he announced that the company was going to sign MoUs with Turkish contractors for construction work in Saudi Arabia.

Current primary energy demand is 280 million barrels of oil equivalent, of which 80% is met by fossil fuels. By 2040, that demand will be 360 million barrels of oil equivalent, with 75% met by fossil fuels, Nasser said.
"Demand in fossil fuels in absolute terms will continue to rise, even though its share will drop," he added.

News release based on the key note speech from Amin Nasser

SAUDI ENERGY MINISTER, KHALID AL-FALIH, SEES OPEC TARGET ON TRACK

Market forces have shifted significantly since 2014, to the extent that Opec only needed a "gentle hand on the wheel", Khalid al-Falih, Saudi Arabia's Minister of Energy, Minerals and Industry said in the keynote address at WEC. With demand and supply rebalancing, Falih was confident that the aims of Opec's strategy announced two years ago were being achieved.

"In 2014, we were seeing North American supply growing much faster than global demand, which was crimped by higher prices. Opec made the vision not to intervene, as this was long-term structural divergence. By June 2015 that divergence had reversed and we are now seeing convergence of supply and demand," he said.
In a question and answer session, Falih said it was not unthinkable that we could be seeing average oil prices of $60 a barrel by year-end—caveating this by saying "my eyes aren't on price—they're on supply and demand," he said.

Falih reiterated that Saudi Arabia doesn't want its role to be shrunk down to targeting a single price for the purpose of optimising the income of the kingdom's economy.
Coordination is critical, particularly with non-Opec suppliers, who need to be at the table as part of a rebalancing effort.
"Opec's mission is clear. We've always said that supply and demand is made up of two factors: market forces and reasonable coordinated action. We continue to believe in an important role for Opec in coordinating discussions with other producers, just as central bankers meet to agree on easing money supply," said Falih.

WEC provided an ideal opportunity for the world's big suppliers to meet to discuss these key issues.
"I will be meeting Russia's energy minister Alexander Novak in the next couple of days to discuss the reaction to what happened in Algiers last month. We're looking forward to Russia playing a constructive role on the global energy stage," said Falih.
By end-November, when the next Opec meeting, it should be much clearer as to where supply and demand is headed.
Many areas were having to deal with lower prices, and Opec must make sure it didn't crimp too tightly and hurt countries' economies. "We don't want to shock markets into prices that could be harmful."

Looking to the future, Falih said the global energy industry must be ambitious —but also pragmatic, in anticipation of a bumpy road ahead. In all likelihood, the coming energy transformation won't be linear and there would be setbacks.
That means building flexibility into the plans, while moving ahead with determination.
Turning to Saudi Arabia, he pointed to the huge transformation underway. "About 65 gigawatts of power generation will be privatised in the next couple of years, along with other state-owned assets. The asset profile of our sovereign wealth fund will approach $2 trillion, making it the largest such fund in the world," said Falih. But Falih's focus goes beyond the kingdom's ambitious transformation programme.

He reinforced the key message that the global energy industry may have enjoyed remarkable success in adapting to change, but today faces other challenges.
"We must build flexibility in order to achieve universal energy access, to build an affordable and reliable modern energy sector that caters for seven billion people and the two billion addition people who will be joining us by 2040," said Falih

CHINA CHARTS COURSE TO LOW CARBON FUTURE

Within the next decade and a half, China is set to become the world's largest conomy. This has massive implications for the world's energy outlook.
According to WEC's World Energy Scenarios 2016 report, global emerging economies such as China are now in the midst of a highly energy-intensive stage of their economic development as they make substantial investments in infrastructure. The report says that in China, topdown, mandated energy efficiency and conservation policies could substantially change energy consumption through to 2060.

Reaching out

Addressing the panel session on China's Energy Outlook to 2016, Kang Yanbing, director of the Energy Sustainability Center at the Energy Research Institute—part of China's National Development and Reform Commission (NDRC)—described his involvement in forging a new roadmap to deal with Chinese specific energy conditions.

"China has become the worlds' biggest energy consume, accounting for 33 percent of world oil consumption. It's carbon emissions now account for one-quarter of the world total," said Yanbing. Underpinning this is massive demographic change. Every one or two years, a population roughly equalling that of Australia moves from the countryside to urban centres.

While coal remains the main component of China's energy mix, Yangbin said the country is leading the world in low carbon energies—solar, hydro and wind —with more than 40 percent of global investment in renewables coming out of China alone. "Our research indicates that in the industrialisation that will come in the next five years non-fossil energy would account for 50 percent and the use of coal would reduce by 60 percent," said Yanbing.

This tallies with WEC's Modern Jazz scenario, under which coal peaks in 2020 in China at 2,080 million tonnes of oil equivalent, and declines at a rate of 2.4 percent from 2020 to 2060. A big change could come as a result of China's growing economic maturity, which has seen it create new international financial institutions that could play a major role in financing green infrastructure and energy.

Leslie Maasdorp, vice president and chief financial officer at China's New Development Bank (NDB) noted that despite China's rise to become an economic superpower, it does not enjoy the equivalent weight on global multilateral bodies such as the World Bank and IMF.
That has led to the creation of the Chinese-backed Asian Infrastructure Investment Bank (AIIB). Today, it has 58 member countries, but in a couple of years could have more than a hundred, as it aims to expand. "It could have a loan book as big as the World Bank's," predicted Maasdorp.

Goals assessed

This could have a major impact on the energy sector. "Our own mandate at the NDB is to invest in capital intensive technologies to reduce crude emissions. We can't invest in coal fired generation, and that is the DNA of the new financial institutions that are being set up."

Maasdorp highlighted the important role of green finance in China's transition into a cleaner and more environmentally sustainable future. The proceeds of green bonds are used to fund green projects, as assessed by third parties. "China has been part of the leadership in the green bond market, issuing special guidelines and being responsible for issuance of RMB 8 billion in green bonds," he said. "There are a series of developments that are opening the landscape of infrastructure finance and China is at the centre of this change." China is also poised to play a much more signinicant role in the emerging global carbon market. "China is looking to launch its own carbon market next year and this cover 5 billion tonnes, which is much bigger than the US and EU equivalents," said Jianyu Zhang, managing director at the China Programme at the US-based NGO, the Environmental Defense Fund. The trajectory is positive, said Zhang. "The NDRC has clearly stated they are working towards initiating real long-term change to encourage low carbon behaviours."

CHALLENGES AND OPPORTUNITIES AS ELECTRICITY ACTORS ENTER NEW FRONTIERS

Addressing market specifics and customer needs is a priority, and new technologies, particularly big data and smart solutions, have a prime role to play, representatives from global utilities companies agreed during a roundtable discussion at the 23rd World Energy Congress.

New smart energy technologies and consumer behaviour are changing conventional wisdom in the electricity supply sector. Decentralised systems can accommodate multiple generation sources closer to end users, optimise renewables input, and encourage increased efficiency. But there is no one-size-fits-all solution.

Michael Bell, President and CEO, Silver Spring Network, emphasised the importance of technology that "creates new industries and disrupts old ones." Bell underlined the importance of smart technologies and of making more information available to consumers. He said, "It is possible to distil big data down to something that is quite tangible for consumers."

Richard Lancaster, CEO, CLP Holdings said, "New business models will be needed and will have to address specific issues in different markets. We have clean technology. It is available and adaptable to different countries and regions."
"We should not think that decentralised renewable solutions are cleaner than centralised renewable solutions or nuclear power. There is a solution for each and every market," he added and underlined the "huge potential of smart home solutions."

Johannes Thyssen, Chairman and CEO, E.ON, said the role of technology and customers are market drivers. "The first driver of change is always technology, followed by customer desire, governments and regulators come after," he said. "Localising businesses to address the people's needs" should be a priority.

"Data ownership and control remains at high level and it is complex to use. It needs to be more accessible to customers, to be localised and accessible... Decisions must be localised and brought as close as possible to customers," he said.

The role of electricity is growing across sectors. "The oil business is moving towards the gas business, and the oil and gas industry in general is moving into the electricity business," said Jean Bernard Levy, Chairman and CEO, EDF.

On the use of big data to design smart technologies, Levy said it was important to "try to anticipate what the right regulations are regarding the use of data. These regulations are a work-in-progress and we need to understand the citizens and governments' views regarding the use of their data."

News release based on the session « Innovative business models: The new frontier »

THE CHALLENGE OF ENERGY EFFICIENCY

With all the talk of switching power generation from fossil fuels to cleaner alternatives, it is easy to forget that the widespread adoption of energy efficiency measures is probably the most effective way to reduce power demand, and thus carbon emissions.
That is the starting point for one of WEC's most important panel sessions—"Energy efficiency: accelerating progress". The session tackled the substantial efforts still needed to deploy energy efficient technologies, urban design solutions and change the behaviour of individuals.
Barriers to change will also come under scrutiny, such as fossil fuel subsidies, poor coordination of international standards— notably in the shipping and aviation sectors —and difficulties in bringing the interests of the owners, users and regulators into alignment.

The WEC, with its wide network of delegates, provides the ideal arena for important players from across the energy sector to work towards solutions to the complex issues involved, according to the session's moderator, Pierre El Khoury, General Director of the Lebanese Centre for Energy Conservation and secretary of the WEC Lebanon Committee.

"The idea is to focus on key success stories in energy efficiency and the lessons learned in order to apply these worldwide," he says. The COP21 climate change talks held in Paris last December, and recent meetings of G20 countries, have resulted in strong backing for greater adoption of energy efficiency measures.

Clear benefits

The advantages of greater implementation of energy efficiency measures are difficult to refute.
The International Energy Agency (IEA) has concluded that, without the avoided consumption generated by efficiency investments between 1990 and 2014, the OECD countries assessed by the organization would have emitted an additional 10.2 gigatonnes of carbon dioxide. Put another way, energy efficiency investments since 1990 avoided the consumption of 520m tonnes of oil equivalent in 2014.

Energy efficiency also makes sense from a financial point of view. Each additional $1 spent on energy efficiency in electrical equipment, appliances and buildings avoids more than $2, on average, in energy supply investments, the IEA estimates.
However, despite the clear benefits for the fight against global warming and for the world's economic prosperity, annual energy intensity improvement around the world lags well below the 2.6% target for the 2010-30 period established by Sustainable Energy for All, a UN-backed platform for global action.

"The COP 21 Paris agreement put huge pressure on decision makers across the world to take concrete action in terms of energy efficiency, but progress remains far away from reaching the objective. We need to expand measures quickly and on a very big scale. Energy efficiency must be tackled with an international approach, not simply with a few applications here and there," says El Khoury.

The need for a holistic approach to implementation of energy efficiency measures is reflected in the make-up of the panel for the WEC session.

El Khoury was joined by Brian Motherway, head of energy efficiency at the IEA; Thorsten Herdan, director-general at Germany's Federal Ministry of Economic Affairs and Energy; Levent Taskin from privately owned engineering firm Danfoss; Bontha Prasada Rao, chairman of Indian state-owned engineering company BHEL and François Moisan, executive director of strategy at the French Environment and Energy Management Agency, ADEME.

The debate covered two main strands: i) how to become more energy efficient on the consumers' side, whether they be in the home or industry; and ii) how to improve energy efficiency in the generation, transmission and distribution of electricity.

Hopeful progress

"The session will be rich because we will focus on energy efficiency from so many different perspectives across the private and public sectors," says El Khoury.
Energy efficiency measures also need to be tailored to the differing requirements of countries with distinct economies.

"The approach to energy efficiency in developed and developing countries is different. For example, in most developed countries, a lot of energy efficiency improvement is achieved during the renovation of existing buildings and facilities. In developing countries, it should be easier, because you can implement efficiency measures at the concept and design stage because more new buildings are being built," he says.

But much remains to be done: "Both developed and developing countries are lagging in terms of energy efficiency and huge efforts must be invested in on all sides," says El Khoury.

AN INSPIRING CHALLENGE

That the global energy mix is going to change fast in coming decades is not in doubt—but the speed of that change and the resulting balance of energy sources remain uncertain. The challenge now is to affect this transformation, while retaining the integrity of global energy systems through new policies, strategies, and innovative investment strategies, energy industry leaders and thinkers told WEC. Finance, technological change, energy efficiency and the need for coherent government policy on how to implement measures to reduce greenhouse emissions were identified as the foundations of change.

The need for strong policy leadership was seen as crucial. "History shows policy drives adoption. I'm optimistic this could happen when I see countries such as India and Mexico building a clear pathway to a sustainable future through policy and investment," Steve Bolze, chief executive of GE Power told delegates.

Isabelle Kocher, chief executive at Engie, agreed, putting into perspective the task facing the industry. "It's a huge and inspiring challenge," she said. "Climate change changes everything and much more than climate, because it is the very first time we must meet a global challenge."

She highlighted the need for clear regulation to encourage the development of power sources if the industry is to rise meet the challenge of meeting the power needs of a world, which the WEC's Scenarios 2016 report says will need to double to 2060.

The report looks at three different scenarios— which it has named modern jazz, unfinished symphony and hard rock—to conclude that meeting this demand with cleaner energy sources will require substantial investment and systems integration to deliver benefits to all consumers, whichever path countries choose.

It is a complex picture, but WEC has been able to highlight some major issues: the need to reassess capital allocations and strategies, target new growth markets in Asia, MENA, and sub-Saharan Africa, implement business models that expand the energy value chain and exploit the disruption, develop decarbonisation policies and address the socioeconomic implications of climate change.
Gerald Davis, executive chair of WEC's World Energy Scenarios, explained its rationale.

As per capita energy demand will peak before 2030 due to greater efficiency and with more stringent energy policies underscored by the imminent ratification of the Paris climate change agreement, the industry needed a complete shift in the way it approached its business, he said.

"We've inherited the infrastructure and the ways of doing things from the last 45 years and we've now got to face these new challenges of the next," he said.

Panellists warned that change would be fast and companies would need to be quick to adapt, noting the rapid improvements in electric vehicle technology that were driving that sector towards entry into the mainstream, and in energy storage.

By 2060, a third of the world's cars could be electric, but they will only be as green as the power that charges them, so the industry faces a major challenge to meet that demand, while still meeting climate change goals.

Fatih Birol, executive director of the International Energy Agency (IEA), emphasised the role of energy efficiency in addressing the challenges of meeting global power demand—the topic of the IEA's Energy Efficiency Market Report 2016, which was also launched at WEC 2016.

"For the IEA, energy efficiency is the first fuel," he said, noting that while countries around the world had differing energy resources, all often had energy efficiency resources.

"Unfortunately, we are not making use of this potential, " he said, focusing on China, where he said strides in improving energy efficiency had contributed to a slowdown in the country's demand growth.

Birol also said nuclear power should not be shunned, given its role as a low emissions producer of baseload power.

Perhaps the biggest untapped potential to improve energy efficiency and cut costs in the industry is in digitisation and improved use of Big Data.
GE's Bolze noted that only 2% of the two terabytes a day of information collected by electricity utilities was currently analysed properly.

"I believe that digitisation will be the single, greatest enabler of the grand transition to 2060," he told delegates. Bolze said digitisation was already helping to improve plant efficiency, reducing unplanned down timesand transmission losses, while enabling consumers to become producers.

Davis said he hoped the Scenarios 2016 report would provide a valuable tool for companies and organisations seeking to make strategic decisions about their future behaviour, whether it involves energy efficiency, power requirements, decisions on stranded oil assets or any number of other considerations. "We've tried to be challenging and plausible—and frank," he said.

REGULATIONS MUST BE DEVELOPED PROPERLY TO ENCOURAGE RENEWABLES

"Regulation is key from the investor point of view in renewables," Carlo Pignoloni, head of Europe and North Africa, Enel Green Power, told the session.
Renewable energy makes up nearly around 30% of the world's installed generation capacity, and and almost a quarter of electricity production. However, wind and solar, in part because of the challenges their variability poses to integration into the power grid, make up less than 5% of generated power.

"What we learned from large-scale renewable integration is that there needs to be better planning for grid management and voltage management, Ziya Altunyaldiz, Committee Chairman, Industry, Trade and Energy Committee, Turkish Grand National Assembly, told the session.

Altunyaldiz added that renewables made up more than 30% of power generation in Turkey in the third quarter of 2016, and installations of wind and solar were increasing with tenders for bigger investments and integration on the way. The Turkish government is working to speed up licensing procedures and develop investment incentives for large renewables projects.
He also said the demand side had to be managed and capacity improvements were needed for transmission and distribution operators, highlighting the importance of storage and smart grids. "Renewables will become game changers when storage comes into play," he said, adding that the energy exchange in Istanbul is developing new tools for intra-day and dayahead markets and balancing.

"Renewables is growing because it is cheapest form of generation today," said Georges Antoun, Chief Commercial Officer, First Solar, adding that a lot of work is being done on forecasting systems, voltage change capabilities and storage on both the grid and vendor side. "There is tremendous opportunity for storage in renewables. When cost of storage batteries become cheaper then these technologies will become widely used," he said.

Boris Schucht, CEO, 50Hertz Transmission, said improved systems control technology was needed but a large share of renewables could be integrated safely. "The more renewables you have, the more control you need. You need to react on volatility," he said. "A wide regional market is needed. On the other side, you need entities that can react locally to optimize within the system. There needs to be global products but local activation of them."

"The barriers to manage different aspects of grid are about overall market structure," Claudio Facchin, President and Global Head of Power Grids, ABB Group, said. "Interconnection on the transmission side is key to deal with the capacity challenge," he stated, adding that integrating battery storage into grid and the digital aspect of the smart grid were important.

A 2016 study by the World Energy Council found that countries need to increase the capacity of both their transmission and distribution grids to accommodate renewables, especially due to the distance of renewable power sources from high-consumption areas. The Council also suggested that technologies such as energy storage and market alterations such as capacity payments would help integrate renewables into the grid more smoothly.

News release based on Renewable energy systems: learning from large-scale integration

INTEGRATING RENEWABLES THROUGH GRID DIGITALISATION

Matteo Codazzi CEO, CESI

Variable renewables now account for over 30% of total installed power generation capacity and 23% of total global electricity production. Wind and solar PV have witnessed an explosive annual growth of 23% and 50% respectively in the past decade.

These figures, revealed in the recent WEC report Variable Renewables Integration in Electricity Systems 2016—How to get it right developed in partnership with CESI, show that the transition towards a low carbon economy is bringing significant positive changes to the electricity industry.

That said, to fully exploit these benefits, we first need to manage the issue of intermittency of renewables, especially when looking at wind and solar power. Existing grids were built when intermittency of generation was not an issue—for renewables to be successfully integrated into generation grids there needs to be significant investment in infrastructure and manufacturing.

Therefore a smooth integration of renewables in electrical systems requires some interventions. From an economic point of view, efficient integration of renewables depends on an effective market design and regulatory framework. It also relies on an increase in connections with solid regional planning.

From a technological perspective, it is necessary to improve operating procedures to optimise reserve capacity and flexibility of generation. It will be even more crucial to develop demand response and demand side technologies further as well as those for energy storage, which will be the single most disruptive technology for the energy industry in the years to come.

The digitalisation of the grid is one of the most important drivers to ensuring there is the necessary flexibility to successfully integrate renewables. By 2030 power grids will have evolved into intelligent delivery systems that support plug-and play integration of intermittent sources according to the US Department of Energy.

Big data management has a key role in this evolution; grid operators will increasingly manage consumers demand more precisely and match variable demand in real time using data insights. In fact, big data technologies could enable demand response by allowing system operators to encourage the decrease of consumption during peak hours or even remotely disconnect unnecessary devices.

By 2025, more than 25 billion 'smart' devices will be simultaneously connected to the electrical grid and to the internet: the estimated 44 trillion gigabytes of data coming in will have to be handled efficiently, extensively and in real time. Utilities and other system operators will increasingly have to think in an agile way, embracing the principles of sharing, open communication and test-fail-learn to address these challenges.

Digital success often means small scale innovation and freedom of operating across never explored business.

In a recent report, Goldman Sachs depicts a 'super cycle' of investments in the digitalisation of European power grids amounting to €145bn in the next decade.

According to a McKinsey report from May 2016 utilities and industries catching up with this new era could see a boost profitability of around 20% to 30%, creating a potential $1.3 trillion market by 2025.

The usual top-down process of big investments on medium and long term prospects has been shaken by the advent of distributed resources and data-driven customer interfaces. Success depends on the capability of the industry to adapt.

NEW AGE NUCLEAR

Agneta Rising, Director General, World Nuclear Association

Electricity demand is rising, and at the same time we need to move towards a durable energy system. Nuclear energy is a sustainable and reliable form of energy that can and should play a larger part of the global energy mix. We recognise that no one technology will be the answer to all energy issues. Limiting our choices makes the task of balancing cost, energy security, and environmental considerations all the more difficult.

At COP21 in Paris, governments committed to making significant reductions in greenhouse gas emissions to limit the effects of climate change. This can only happen if we use all sources of low-carbon energy, including nuclear.

Fossil fuels have been remarkably versatile and scalable forms of energy that have provided the backbone for the development of human civilisation since the industrial revolution.

The fact that burning fossil fuels releases greenhouse gases which contribute to an accelerated and dangerous rate of climate change is, put simply, a tragedy.

A clear path to decarbonisation is set out in the International Energy Agency's (IEA's) two degree scenario. In this scenario nuclear energy has the largest single role to play of any generation technology. Expanding to supply roughly 17% of electricity by 2050 requires substantial capacity addition far beyond the rate of new build we see in the Western world today, but similar to the levels seen in the 1980s.

Here it is worth noting however that while nuclear energy is a technology proven at almost any scale in a system we still don't know if large-scale intermittent renewable deployment, energy storage or CCS will turn out to be technically or economically viable.

It is important to provide reliable as well as clean power supplies. Intermittent and weather-dependent low-carbon electricity sources such as solar and wind need to be complemented by dispatchable and reliable sources of power. Apart from hydro, nuclear is the only source of low-carbon dispatchable generation currently operating at scale.

We should expand the use of nuclear energy to supply 25% of electricity by 2050 and form part of a diverse mix of available low-carbon generating technologies.
We have set a goal of building 1,000GW of new nuclear generation capacity by 2050, so that nuclear energy supplies a quarter of the world's electricity, with the remainder being supplied by other low carbon sources. That figure easily fits within the baseload profile of most countries, and could readily be met by currently available reactor technology.

To achieve this would require a progressive ramping up of new nuclear construction, with 10GW being added each year to start with, rising to an average of 33GW being added each year from 2026-2050. These targets are comfortably achievable.

10GW of new nuclear capacity was added in 2015, and historic highs of new nuclear capacity additions in the 1980s exceeded the 33GW per year maximum target build rate.

Achieving this target for nuclear generation will need action in three key areas: a level playing field in electricity markets; harmonised regulatory processes; and an effective safety paradigm.

We need a level playing field in electricity markets that provides equal recognition to the reliable, low carbon nature of nuclear generation.

Markets should value not only levelised costs, but also system reliability and environmental benefits.

We need harmonised processes to improve cooperation between regulators. If we do this we can realise the benefits from global codes and standards, and more efficient licensing of current and new technological developments.

We also need an effective safety paradigm, where the excellent record of nuclear generation is put in full context with those of other forms of generation.

This should increase genuine public wellbeing by reducing emissions from polluting sources, and ensuring high nuclear safety standards are met.

The nuclear industry must show the way. The harmony of purpose that characterised national nuclear programmes in the early years has to be applied now to the global enterprise.

AN AGILE LEAP

Energy companies are seeking to play a full part in the energy transition of coming years, taking advantage of new opportunities created by the need for lower carbon emissions and more creative ways to get power to the market.

Alexander Medvedev, Deputy Chairman of Russia's Gazprom told WEC that mankind was no longer prepared to sacrifice the environment and health for the sake of energy supply.
As a result, gas, as the cleanest fossil fuel, still had a key role to play in the energy mix, given its ubiquity and reliability as a partner for intermittent renewable energy.

Achieving a commitment to keeping global warming to less than 2% lower than pre-industrial levels would not be possible without gas, given the lack of cleaner alternatives that could meet growing energy demand in the next two decades. "The only way to sustain economic growth is through the combination of gas and renewables," he said, adding that it would be a mistake to think of gas as a fuel of the past.

Medvedev said he expected global natural gas demand to increase by 1.2% or more for the next 10-30 years. LNG is likely to play an important role in meeting that demand and to that end, Gazprom is beefing up its investment in the Sakhalin 2 plant with partners Royal Dutch Shell and Mitsui. The company plans to have a third 5m tonnes per year train in operation at the facility by 2021, and Medvedev told WEC that there may even be enough gas for a fourth train.

Gazprom has said 7-8bn cm/y of gas would be needed for a third train, while Medvedev suggested a new field could contain several times that amount.

Another perspective came from Güler Sabanci, chairman of Sabanci Holding— one of Turkey's largest financial and industrial conglomerate.

As a major component in the Turkish power sector, Sabanci will be one of the key players in ensuring that the cleaner electricity gets to a fast growing population.

Enerjisa, a joint venture between Sabancı and Germany's EON, announced in August that it planned to invest some $1.5bn in power distribution between 2016 and 2020.

"Going forward, liberalisation of electricity and gas markets must be our ultimate goal," said Sabanci, describing herself as more of a fan of Modern Jazz—one of the three distinct global energy sector development outlooks identified in WEC's Scenarios 2016 report, published on Monday.

Modern Jazz foresees a large role for the market in arriving at a low carbon energy world.

Sabanci said it was important to remember that renewable energy and energy efficiency measures were not the only prongs of the fight to mitigate climate change. Energy storage had the potential to change the dynamics of power generation, while the digital revolution would create prosumers out of consumers. She noted that Turkey, which has a median age of around thirty years old, would be in the vanguard of this revolution given the propensity of the young to master digital technology.

LES RESSOURCES ÉNERGÉTIQUES MONDIALES

LES RESSOURCES ENERGÉTIQUES MONDIALES

PRINCIPALES CONCLUSIONS

The World Energy Resources have been produced by the World Energy Council for over 80 years. The details and analysis provide a unique data set that allows governments, private sector and academia to better understand the reality of the energy sector and the resource developments. The assessments are compiled with our network of member committees in over 90 countries along with a panel of experts who provide insights from across the globe. With information covering more than 180 countries, this is the 24th edition of the World Energy Resources report.

The report includes 13 chapters, which cover coal, oil, gas, uranium & nuclear, hydropower, bioenergy, waste-to-energy, solar, geothermal, wind, marine and two cross cutting topics, energy storage and CC(U)S. The reputation and value of the study rests on three main factors: the study presents unbiased data and facts from an independent and impartial organisation, it covers technological, economic and environmental aspects of conventional and renewable sources, and it provides assessments on global, regional and country levels prepared by an international network of respected experts.

Les ressources énergétiques mondiales sont produites par le Conseil Mondial de l'Énergie depuis plus de 80 ans. Les détails et l'analyse fournissent un ensemble de données unique qui permet aux gouvernements, au secteur privé et aux universités de mieux comprendre la réalité du secteur de l'énergie et l'évolution des ressources. Les évaluations sont compilées par le réseau de comités membres dans plus de 90 pays, avec un panel d'experts qui fournissent des informations de partout dans le monde. Avec des informations couvrant plus de 180 pays, il s'agit de la 24e édition du rapport sur les ressources énergétiques mondiales.

Le rapport comprend 13 chapitres couvrant le charbon, le pétrole, le gaz, l'uranium et le nucléaire, l'hydroélectricité, la bioénergie, les déchets énergétiques, le solaire, la géothermie, l'éolien, l'énergie marine et deux sujets transversaux, le stockage de l'énergie et la capture du carbone. La réputation et la valeur de l'étude reposent sur trois facteurs principaux : l'étude présente des données impartiales et des faits provenant d'une organisation indépendante et impartiale ; elle couvre les aspects technologiques, économiques et environnementaux des sources conventionnelles et renouvelables ; et elle fournit des évaluations aux niveaux mondial, régional et national préparées par un réseau international d'experts respectés.

Synthèse et rapport disponibles sur : http://wec-france.org/etudes.php

TRIBUNE DE JEAN-MARIE DAUGER

MEMBRE DU CONSEIL D'ADMINISTRATION DU CONSEIL FRANÇAIS DE L'ÉNERGIE ET CO-PRÉSIDENT DU WORLD ENERGY COUNCIL

Au total, en dépit d'une organisation un peu chaotique (merci aux équipes de Londres d'avoir pallié, discrètement mais efficacement, les petits défauts de la logistique locale) et en dépit de l'impact, finalement contenu, des événements de cet été sur la participation, ce 23e congrès peut être considéré comme un vrai succès.

C'est un succès par le niveau de participation : la présence pendant une demi-journée de quatre Présidents, dont Erdogan et Poutine, reprenant dans leurs discours des référentiels du World Energy Council, a donné une aura particulière à cette édition. La dimension politique de cet événement n'a pas éclipsé, bien au contraire, à la notoriété du World Energy Council, mais bousculé le planning des séances de travail (merci encore aux équipes de Londres qui ont été réactives et flexibles pour reconstruirer en temps réel plusieurs fois le programme sans susciter de mécontentements.

La présence de très nombreux membres de gouvernements (plus de 60 ministres) a donné du lustre à l'événement mais fourni de très nombreuses opportunités de contacts aux entreprises présentes : le WEC et son congrès restant un réseau d'interconnexion unique en son genre. Outre les vedettes telles que les ministres saoudien, russe, quatari,… et turc, de très nombreux ministres d'Afrique étaient également présents - une demi-journée était entièrement consacrée à l'Afrique.

Peu d'Américains, peu d'asiatiques (effet des récents événements ayant frappé Istanbul) mais somme toute une bonne participation, y compris dans les ateliers pourtant fort nombreux (de mémoire plus de 200).

Une présence de CEO de bon niveau : Shell, BP, Aramco, EDF, TOTAL, ENGIE, E.on,… et de nombreuses entreprises turques sont venues au congrès.

Les débats étaient généralement de bonne facture, même si la langue de bois n'est jamais pas totalement absente lorsque l'excès de participants par session réduit par trop le temps de parole.

L'unanimité s'est faite sur le fait que demain ne sera plus jamais comme hier et sur la nécessité de diversifier le mix énergétique, de libérer les technologies et d'inventer de nouveaux business models. Les hypothèses émises par le World Energy Council d'un risque de « réserves échouées » de pétrole a été contesté par les pétroliers et la Russie.

Le gaz a été très présent dans les débats ainsi que les renouvelables le pétrole et la technologie, silence sur le charbon,

Malgré l'accent mis sur la croissance de l'électrification des économies, les entreprises électriques, bien que largement représentées, sont restées plus discrètes. Le pétrole et le gaz ont donné lieu à des déclarations plus stratégiques et mieux structurées. Aucune contestation de l'urgence climatique, la COP 21 est une avancée majeure qui change la donne... mais que va t-il se passer ?... Il faut le CCUS et le stockage de l'électricité mais qu'est-il raisonnable d'en attendre et quand...? Bref, les champs du possible et le calendrier sont encore très ouverts. Le Congrès a aussi été l'occasion d'une présentation détaillée des nouveaux scenarios à long terme du WEC.

En tous cas, l'intervention des états dans le secteur énergétique ira sans doute croissant mais l'efficacité requiert de laisser une place importante au marché…

Certains ateliers fermés (CEO et Ministres) auraient pu être plus dynamiques. Les entreprises françaises ont été plutôt discrètes, alors même que leur représentation était significative. Le temps où les grandes utilities européennes animaient les débats semble révolu. Absence de la filière nucléaire

française (sauf edf) et d'ailleurs peu de mentions du nucléaire en général sauf par les Russes et les Chinois.

Les premiers retours du dépouillement des questionnaires remis aux participants après chaque session font apparaitre un bon niveau de satisfaction.

David Yonghoon Kim (président et ceo du groupe coréen Daesung) préside désormais le WEC.

Le prochain Congrès du WEC, en 2019, se tiendra à Abu Dhabi.

Autres tribunes : Olivier Appert (page 36) et Bruno Lescoeur (page 66)

Jour 3

Le trilemme énergétique : des solutions politiques pour assurer la prospérité

SUSTAINABLE ENERGY TRANSITION NEEDS COOPERATION

Successfully navigating the transition to a cleaner, sustainable energy future will require regional/global cooperation on an unprecedented scale, energy leaders told the World Energy Congress.

"I don't know any energy transition that can be done in a decade. It's also a matter of cooperation," Doris Leuthard, head of the German government's department of Environment, Transport, Energy and Communications, said. "No country on its own can solve this and drive the world in the right direction."

Balancing the Energy Trilemma—a term coined by the World Energy Council referring to the balancing act between security, equity, and environmental sustainability— will require a swift and smooth transition to a lower carbon energy system.

Global demand for electricity will double between now and 2060, according to WEC. Meeting this demand with cleaner energy sources will require substantial infrastructure investments and systems integration to deliver benefits to all consumers.
This is especially true for developing countries, struggling to connect large parts of the population to their power grids.
Last year, 95 countries adopted an agreement, which for the first time was legally binding, to curb carbon emissions.
The deal agreed at COP21 stated that countries would take measures to limit temperature rises to well below two degrees Celsius. The agreement is due to come into force in 2020.
However a new study released by the WEC suggests that despite a larger uptake in renewable power the world's carbon budget will be exceeded within the next 30 to 40 years.
François Austin, Global Energy Practice Leader, Oliver Wyman, says fossil fuel producers must prepare to adapt to a lower carbon world.
"It's critical that those fossil fuel players are involved. They're going to have to change their business models, financially and operationally," Austin said. "It's an industry that hasn't managed adaptation well but those organisations are also transitioning themselves."

THREE-WAY TIE

Jeroen van der Veer, ex-CEO Shell, Chairman ING

The United Nations bas projected a severe global water shortage by 2030; that the world will be faced with a 40% shortfall of water availability. This stark prediction becomes even more pertinent when you look at current models of power generation; 98% require water at some point in the process.

Such is the state of affairs that from 2014 to 2069, reductions in usable water capacity could impact two-thirds of hydropower plants analysed and more than 80% of the thermal electric power plants assessed.

Energy is the second largest freshwater user after agriculture; the interdependence of these resources and the way in which they compete for die same scarce resources is known as the 'energy-water-food nexus'.

If we are to mitigate the impact of this water shortfall it is crucial that government and industry work together to innovate and explore how this precious commodity can be used more efficiently in energy production. Water is utilised right across the energy value chain —in both primary energy production (coal, oil, gas, biofuels) and in power generation (hydro and spentfuel cooling for nuclear waste).

To mitigate resource constraints, it is essential to further reduce the amount of water needed for energy production. Analysis by the International Energy Agency in 2012 indicated that the water footprint of the energy industry could be reduced by producing more heat and power with renewables such as wind, natural gas and photovoltaics —as comparably the water usage is much lower.

There is a fine balance to strike between championing the transition to a low carbon future and reducing water stress. Pakistan's Indus River Basin, accounting for more than 9596 of the country's irrigation and the majority of its food production, is facing increased water stress due to die impact of climate change on glacial fiows. At the same time, the country is looking to boost its energy supply by tapping into the area's hydroelectric potential — creating further water stress.

Moving forward energy production methods that incorporate water availability into their design must balance concerns regarding energy security, environmental sustainability and affordability.

Some technologies highlighted as part of the low-carbon transition, may actually increase water stress such as biofuels, carbon capture and storage almost doubling the water requirements.

Technology also has an important role to play in reducing water stress too. Advances such as 'recirculating' systems as opposed to 'once-through' systems, the adoption of dry cooling, improvements in desalination processes, and reusing water from oil extraction have been progressively deployed to reduce the water footprint of the energy sector. However, a lot more must be done.

One of the key considerations which needs continued attention is how this technology and development is funded. A UNEP report produced earlier this year in conjunction with Frankfurt School of Management and Finance bas put global investment in renewable power capacity in 2015 at $285bn —more than double that allocated to new coal and gas generation. Geographically (excluding hydropower) the majority of this came from developed countries, with China, India and Brazil being the largest contributors from the developing world.

This investment has come from a combination of venture capital, and corporate and public sector R&D. Solar energy, one of the least water-intensive forms of energy generation, garnered $161bn in 2015 against small hydro projects which attracted $3.9bn.

Equally, some of the burden falls to policy makers to ensure market conditions are ripe to encourage investment in renewables. The latest Trilemma report published by the World Energy Council explores the use of market-used economic instruments alongside carefully, selected mechanisms to

correct market failures such as 'green' or infrastructure banks. Additionally, green bonds, well-designed public-private partnerships, and carefully applied subsidies, can also yield significant returns.

When managing the transition to a low carbon economy and improving access to reliable energy sources a fine line will inevitably trodden with reducing water stress. Several of the most water stressed regions in the world are those which are positioning themselves at the forefront of the renewables revolution and are poised to see continued economic development and a population boom.

Parallel to the growing demand for water, the risks of the nexus are further exacerbated by the increased uncertainty about water availability and quality. These risks are driven by climate change impacts such as declining freshwater availability, increased ocean temperatures and more extreme weather.

The level of global water stress exacerbates the need for collaborative working that will foster the necessary innovation to produce solutions which will reduce water usage in the production of energy whilst balancing energy security, affordability and access to energy. Firstly a shift towards renewables such as wind, photovoltaics, or natural gas would mitigate the environmental impact of ensuring energy security. Equally the adoption of Carbon Capture and Storage technology (especially after 2030) will be vital te managing this transition.

BP CHIEF FLAGS UP THE THREE Cs

Energy businesses are faced with hard choices in an increasingly competitive market— ones that determine success or failure. This stark message carried credibility, delivered by Bob Dudley, the CEO of BP.

The supermajor's CEO keynote address to the World Energy Congress stressed that the world has become much more competitive, with abundant supply now keeping prices low. At the same time, we are more aware than ever of the need to reduce carbon emissions. Dudley used his speech to look at three main challenges—the Three Cs as he put it: competitiveness, carbon and choice.

"We're going through a time during which supply has outstripped demand. Technology has continued to unlock new sources of supply—notably shale oil and gas in the US. At the same time, global demand growth has slowed from the extraordinary pace of the past 20 years."
As a result, energy is abundant and the pressure to become more competitive at lower prices has increased. Companies must be competitive in a way that's different from the past. "In previous cycles, as an industry, we have let costs drift up when prices are high, then cut back when prices fall. From now on, the challenge is to build—and sustain—businesses that are good through all cycles," said Dudley.

The risk of losing discipline on costs is evident, but there are ways of preventing that from happening.

First, through a constant focus on simplification, cutting out waste, improving efficiency and driving up reliability.

Safety is really important here. "At BP we have seen our numbers on efficiency and reliability go up at the same time as safety has improved. They go hand-inhand," said Dudley.

The second is being innovative with business models. "One recent example at BP is the deal we have done with Det Norske in Norway, where it has combined the strengths of both companies in a new business called Aker BP—which brings together Det Norske's streamlined operating model and our technical skills, international experience and knowledge of the Norwegian offshore, built up over decades."

A third step is to take full advantage of technology. "Things that used to take months—like the analysis of seismic data—are taking hours as a result of supercomputing. That means we can find answers to problems in seconds, with a huge impact on productivity," said Dudley.

On the carbon challenge, momentum for action has been growing for some time.

"For more than 15 years we have supported the Carbon Mitigation Initiative at Princeton University in the US which has been a leader in research into the science of climate change and potential policy solutions. And we have invested a substantial amount in low carbon businesses," said Dudley.

Dudley also highlighted collaborative action in looking at the potential of carbon capture use and storage (CCUS).

"We know CCUS has the potential to play a major role in the future as part of the solution to meeting higher energy demand with lower emissions, and will be essential in a tightly carbon-constrained world."

On the third challenge, choice, BP has been forced to make several investment and divestment decisions in recent times.

"Part of the competitiveness challenge is that we cannot cut everything. We need to keep investing for future growth and that means making big choices to sanction big projects."

BP's recent investment decisions—such as the expansion of the Tangguh LNG plant in Indonesia, the massive Khazzan tight gas project in Oman; and the Shah Deniz 2 project in Azerbaijan—have one thing in common: they are all natural gas projects. This underscored a very important shift, said Dudley.

While renewables are growing quickly into the energy economy, it will take time to grow from a base of around 3% of the energy mix today.

"Even if renewables were to grow faster than any fuel has done, they are unlikely to contribute more than 15% of the total energy mix by 2035," he said.

That is why there has to be an increasing role for natural gas as a substitute for coal, allowing us to limit carbon quickly and at scale while meeting the energy needs of developing countries.

"In BP we are already around 50% natural gas now and heading towards 60% by the end of the decade as new gas projects come on stream," he said.

GAS: FROM DARK AGES TO GOLDEN AGE?

The gas industry is undergoing profound structural change, with liquefied natural gas shifting from a rigid to a far more flexible infrastructure.
That was a key message from the WEC panel session on LNG markets.

As panel chair Muqsit Ashraf, Managing Director & Global Head of Energy Practice, Accenture Strategy noted, the industry has moved from an age where only a small faction of LNG was traded on spot or short-term contracts, to one where one-third is traded in this way. "A lot has happened and unquestionably a lot more change will happen, as the reconfiguration of the market continues," he said.

Roger Bounds, VP, Global Gas, Royal Dutch Shell, noted increasing LNG demand emerging from new markets. "Places that used to export LNG, such as Malaysia, and Indonesia," are now importing. That trend will deepen over time." He said.
Japan has long been at the epicentre of the market, and low prices have impacted the diversification of its supply sources.

According to Shigeru Muraki, executive adviser to Tokyo Gas Co, Japan is expecting new supplies to come from the US, Canada, Alaska, East Africa and Russia, to supply the region's largest market. Muraki was confident that despite the diversification, the oil indexation will remain a constant in future contractual negotiations, though "there will be a price slop introduced gently to reduce the risk of price volatility," he predicted.

The likelihood is that most US LNG— which is free of destination clauses—will continue in this way. Andrew Walker, VP of strategy at Cheniere Marketing acknowledged that the gas sector finds itself grappling with bigger questions reshaping the primary energy industry.

The US is changing the marketplace, he said. Large-scale supply is under development, with some 60 million tonnes of production planned—equivalent to one-quarter of current capacity. Power has been put back in the hands of buyers, who were now setting the agenda for what they need. "Gas is no longer a captive market. It's competing with renewables, in an increasingly liberalised marketplace."

For David Hobbs, Head of Research at King Abdullah Petroleum Studies and Research Centre, the key theme facing gas is dependence. "The challenge for anything trying to grow in this market is the extent to which full cycle costs can compete with marginal costs of whatever is in there already. Looking 20 years ahead, the battle is being fought out today and the consequences will reverberate for a long time."
Hobbs challenged the conception of natural gas as transition fuel. "That is is an OECD construct. It's about how does gas survive in what is perceived to be a static market. Europe has seen little energy demand growth in the last decade. The US has also seen little growth in energy demand, even if gas has grown within that. But to industrializing economies, they don't think about transition fuel; they think of it just as fuel."

Natural gas will struggle to be seen as a low cost alternative to coal or renewables. "There's what is fundable by the multilaterals— renewables. Or there is what is cheap—coal," said Hobbs
The panel was optimistic. As Hobbs pointed out, many have underestimated the extent to which the industry can eliminate costs. "While gas has been through the 'new dark ages', this dose of reality is a kicking off point that leads to a future golden age," he said.

DEVELOPMENT FINANCE FOR THE ENERGY TRILEMMA

Suleiman J Al-Herbish, OFID

The most commonly accepted estimate of the financing needed to secure universal energy access by 2030 was made in the SE4ALL Global Tracking Report 2015.

This forecasts an annual investment requirement of $50bn. However, based on commitments, the International Energy Agency foresees an average of only $19bn being invested in power plants and associated infrastructure yearly through 2030.

To bridge this gap, innovative approaches will be needed to tap resources. Other important factors to consider include the variety of technology solutions, the multitude of stakeholders and the diversity of regional and national circumstances.

With regard to attracting finance, one of the biggest obstacles is the perceived risk element, since energy access projects are predominantly small-scale and target poor communities. But options are available. Aggregation solutions are financial clustering mechanisms that convert a broad range of small projects into pools large enough to reduce transaction costs and meet investors' requirements.

In providing energy access, an important stakeholder group is SMEs. Due to their size, companies of this size have little access to traditional finance. Instead, multilateral development banks and DFIs often play a prominent role. OFID, for example, is an equity partner in The Energy Access Fund (EAF), an impact investment fund sponsored by Schneider Electric. The EAF supports energy-related SMEs through equity investments of €2.5m-€5m.

It is local banks, however, that are better equipped to offer loans to the local private sector. International aid agencies should also provide assistance to the local financial sector, including credit enhancement and risk mitigation, in addition to capacity building. For OFID, this worked successfully in the case of its $10m loan to Armenia's Ardshinbank, which is using the financing to fund local SMEs involved in small-scale hydropower plants (SHPPs).

The examples of innovative financing solutions are numerous, but what will underpin financing for universal access to modern services is the creation of an investment enabling environment. This must be politically, institutionally and economically stable at the macro-level, and have a regulatory framework at the micro-level. For instance, a key factor in approving OFID's loan to Ardshinbank was the political commitment of the Armenian government to promoting SHPPs. Another key element in the successful financing of projects is the commitment to the power purchase agreement (PPA).

An illustration of the importance of policy clarity and stability is drawn from OFID's experience with a mini-grid-project in India. For mini-grids projects, given the long-term investment perspective needed to develop them, private investors' involvement may be deterred if they are not assured that schemes will not be superseded by connection to the national grid.

Finally, a key barrier limiting wider access to modern energy services by the poor is their lack of ability to pay for services. Pro-poor "smart" subsidies can extend energy access for rural and poor people.

Such subsidies should be transparent, well oriented and should reach low-income households. Cross-sector taxes/subsidies can be a self-sustained financial approach to the benefit of small-scale energy access projects. For example, the tariff paid by grid-connected customers could be adjusted slightly upward in order to provide subsidies to mini-grid projects in remote areas.

TRILEMME ÉNERGÉTIQUE MONDIAL
INDICE DE DÉVELOPPEMENT DURABLE

The Energy Trilemma Index, produced in partnership with global management consultancy Oliver Wyman, along with the Global Risk Centre of its parent Marsh & McLennan Companies, ranks 125 countries' energy performance in order of how well they address the Council's widely-used definition of energy sustainability, which is based on three core dimensions: energy security, energy equity, and environmental sustainability. Each country is given an index ranking as well as a letter grade denoting its performance in the individual dimensions.

Detailed country profiles as well as regional analyses allow policymakers and energy leaders quick access to the most crucial information while at the same time offering the possibility of engaging in more in-depth comparison with regional or economic peers. To enhance the utility of the report even further, the 2016 Index is accompanied by the launch of its interactive online tool. The tool includes country and regional overviews, maps and a pathway calculator which allows users to manipulate selected key energy indicators to explore how their country's index ranking could evolve.

The 2016 Index, especially if considered in conjunction with its companion report, the 2016 World Energy Trilemma, which identifies five key focus areas to drive progress on the Trilemma, can support the necessary timely action to move towards sustainability.

L'indice du trilemme énergétique, produit en partenariat avec le cabinet de conseil Oliver Wyman et le Global Risk Center de Marsh & McLennan Companies, classe le rendement énergétique de 125 pays en fonction de la façon dont ils répondent à la définition largement utilisée de la durabilité énergétique du Conseil, qui repose sur trois dimensions fondamentales : la sécurité énergétique, l'équité énergétique et un environnement durable. Chaque pays reçoit un classement d'indice ainsi qu'une note de lettre indiquant son rendement dans les dimensions individuelles.

Des profils détaillés de pays ainsi que des analyses régionales permettent aux décideurs et aux dirigeants de l'énergie d'accéder rapidement aux informations les plus cruciales tout en offrant la possibilité de s'engager dans une comparaison plus approfondie avec les pairs régionaux ou économiques. Afin d'améliorer l'utilité du rapport, l'indice 2016 s'accompagne du lancement de son outil interactif en ligne. L'outil comprend des aperçus nationaux et régionaux, des cartes et un calculateur de parcours qui permet aux utilisateurs de manipuler des indicateurs d'énergie clés choisis afin d'explorer comment le classement de l'indice de leur pays pourrait évoluer.

L'indice 2016, en particulier s'il est examiné conjointement avec son rapport d'accompagnement, le trilemme énergétique mondial 2016, qui identifie cinq domaines clés pour faire progresser le trilemme, peut soutenir l'action nécessaire en temps opportun pour aller vers un développement durable.

Synthèse et rapport disponibles sur : http://wec-france.org/etudes.php

LES MESURES NON TARIFAIRES

The World Energy Perspective on Non-tariff Measures is the second report in a series looking at how an open global trade and investment regime concerning energy and environmental goods and services can foster the transition to a low-carbon economy.

Building on the previous report on tariff barriers to environmental goods, this paper highlights twelve significant non-tariff measures (NTMs) directly affecting the energy industry and investments in this sector. The World Energy Council has identified that these barriers can greatly impact a country's trilemma performance – the triple challenge of achieving secure, affordable and environmentally sustainable energy systems.

Through this work, the Council seeks to inform policymakers as to what extent countries should address non-tariff measures to improve trade conditions, and eliminate unnecessary additional costs to trade, ultimately fostering national economic development.

Reducing and eliminating trade barriers is key to catalysing the low-carbon economy and enabling countries to develop sustainable energy systems. Thus, positively impacting on all three aspects of the energy trilemma, through reduced cost of technology and energy itself, enhanced energy security and transition to a low-carbon energy system.

La perspective mondiale de l'énergie sur les mesures non tarifaires est le deuxième rapport d'une série qui examine comment un régime mondial ouvert au commerce et à l'investissement en matière d'énergie et de biens et services environnementaux peut favoriser la transition vers une économie bas carbone.

S'appuyant sur le précédent rapport sur les barrières douanières aux biens environnementaux, le rapport met en évidence douze mesures non tarifaires significatives (MNT) affectant directement l'industrie énergétique et les investissements dans ce secteur. Pour le Conseil Mondial de l'Énergie, comprendre et s'attaquer aux mesures MNT qui affectent le secteur énergétique bas carbone devraient être un des efforts prioritaires des pays pour réussir à équilibrer le trilemme énergétique (sécurité énergétique, équité énergétique et environnement durable).

Grâce à ce travail, le Conseil cherche à informer les décideurs sur la mesure dans laquelle les pays devraient prendre des mesures non tarifaires pour améliorer les conditions commerciales et éliminer les coûts supplémentaires inutiles pour le commerce afin de favoriser le développement économique national.

Réduire et éliminer les barrières commerciales est un facteur-clé pour favoriser une économie bas carbone et permettre aux pays de développer des systèmes énergétiques durables. Cela a eu un impact positif sur les trois aspects du trilemme de l'énergie, grâce à la réduction des coûts de la technologie et de l'énergie elle-même, à une sécurité énergétique accrue et à la transition vers un système énergétique bas carbone.

Synthèse et rapport disponibles sur : http://wec-france.org/etudes.php

TRIBUNE DE BRUNO LESCOEUR
CONSEILLER SPÉCIAL DU PDG D'EDF

La séance inaugurale du congrès mondial de l'énergie d'octobre 2016 à Istanbul, présidée par R. T. Erdogan, qui avait convié le président russe Poutine, l'azéri Aliev et le vénézuélien Maduro, sans oublier le président de la république turque de Chypre, a brillamment et longuement rappelé la dimension éminemment géopolitique des questions énergétiques. L'industrie, quant à elle, a parfaitement compris que la préoccupation du changement climatique, après les accords de Paris, affectera toutes ses activités et dans toutes les parties du monde ; mais bien évidemment de façon différente selon les pays ou régions, dont les intérêts et les contraintes sont toujours plus divergents. La géopolitique du climat n'est pas moins complexe que celle de l'énergie et les débats consacrés à l'Afrique l'ont bien révélé.

Le consensus est général : la transition énergétique sera une transition vers un monde tout électrique ! On n'a jamais autant parlé d'électricité, mais les compagnies électriques n'ont jamais été aussi discrètes dans leur expression.

En revanche les pétroliers, qui réclament un prix du carbone, ont les idées parfaitement claires sur leur feuille de route pour cette transition énergétique dans une période de faiblesse des prix du pétrole : faire leur travail d'industriel d'amélioration de leur productivité à court terme, et préparer leur avenir dans un monde plus électrique à long terme, avec un passage à moyen terme par le gaz. On a même eu parfois le sentiment que le WEC devenait une enceinte de discussion pour l'OPEP et ses partenaires.

La réprobation du charbon est générale, mais les espoirs de s'en passer rapidement ne sont plus très argumentés.

Les progrès technologiques, la « digitalisation » de l'économie et les réductions de coûts associées tant pour les nouveaux moyens de production que pour des usages énergétiques toujours plus efficaces, sont universellement célébrés ; mais les conditions à réunir pour qu'ils se diffusent à l'échelle industrielle et au niveau des enjeux de la planète sont encore très difficiles à énoncer. La contradiction entre une vision d'un monde de plus en plus urbanisé dans des mégapoles géantes et des espoirs de solutions toujours plus « smart » et décentralisées tendant à l'autonomie énergétique, n'est toujours pas résolue mais elle est au moins reconnue.

Le nucléaire est de nouveau unanimement considéré comme faisant parti de la solution, sauf par l'Europe bien sûr. L'industrie nucléaire mondiale était fort bien représentée, les chinois, par les deux présidents des trois principaux acteurs, les russes, par Poutine lui-même, les indiens, les coréens et les japonais et même (via leur intermédiaire Westinghouse) les américains, par ailleurs très discrets à ce congrès.

Le pays le plus riche en gaz bon marché, d'une part (la Russie par la voix de W. Poutine), et le pays le mieux doté en solaire, d'autre part (les Émirats par la voix de leur ministre, tout fier d'annoncer un coût de 30 USD/kWh photovoltaïque à condition d'en faire à large échelle) ont tous deux expliqué sereinement que le nucléaire était indispensable à la transition énergétique !

L'Europe brillait par son absence sur ce sujet. Mais plus généralement, trop occupée par ses débats internes et ses problèmes de riche, elle donnait une impression d'impuissance au plan géopolitique, énergétique et climatique, voire d'inexistence, en simple donneuse de leçons dans un monde qui tourne dorénavant sans elle. À son propos, on peut citer W. Churchill, « si le changement est inévitable, le progrès ne l'est pas » ; tous les espoirs sont donc permis.

Autres tribunes : Olivier Appert (page 36) et Jean-Marie Dauger (page 54)

Jour 4

Afrique : assurer un avenir énergétique durable

TIME TO CLEAN THE POWER SECTOR

Nations across the globe must do more to promote and increase the share of low carbon fuels in their power generation mixes, the UAE energy minister told.

"In the UAE we believe one of the pillars of society is clean energy. There is a role for us as government to enable this shift from being purely dependent on fossil fuels to allowing competition from newer forms of energy," energy minister Suhail Mohamed Al Mazrouei said. "We must all make a commitment to it. You need to look at 2050 and think: what is your plan? What energy mix are you aspiring to? We're trying in the UEA to manage that shift."

Lower oil prices have prompted some Gulf oil producers to shift their focus to alternative fuels. Despite holding some of the largest resources of oil and natural gas in the world, the UAE is planning to fully diversify its energy mix.

Mazrouei has previously said the country plans to invest $35bn in clean energy by 2021, with the focus on nuclear and solar projects. He has suggested the country will increase the share of renewables to 30%, while reducing natural gas' share to 70%, compared with its near 100% share of power generation feedstock.

Rising economic and population growth over the past decade have also put pressure on the UAE's power sector capacity.
The country's electricity consumption is among the highest per capita in the world, according to the US Energy Information Administration (EIA).
Demand for power is expected to rise by 50% by 2020, the organisation says, up from around 105bn kilowatthours (Kwh) in 2013. The UAE generates most of its electricity using natural gas-fired generation. It is also investing in renewable energy technologies and has committed to produce at least 7% of total power generation from renewable sources by 2020.

Mazrouei said the UAE had managed to reduce the cost of solar power generating capacity to less than 2.5c/Kwh.
"A few years ago this was unheard of. We have opened the door for solar in a big way," Mazrouei said. "And we have seen a great advancement from the technology when we allow for competition. The next technology we need is storage. If we have that it (renewable energy) will be a reliable source of power, and a steady form of energy."

The UAE plans to build seven new power plants to come online by 2021 with a combined capacity of 9.5 gigawatts (GW), according to the EIA. One of these includes a plan for a cleancoal facility in Dubai with a capacity of 1.2GW.

The first phase of the clean coal project should begin operating in 2020. The UAE's Integrated Energy Strategy 2030 has set targets for 12% of power generating capacity to come from clean coal, 12% from nuclear, 5% from renewable energy and 71% from natural gas by 2030.
Planned nuclear energy construction projects are expected to add at least 5.6 GW of capacity, the EIA says. The first reactor is scheduled to come online in 2017, with the others completed by 2021.

Rainer Baake, the German government's State Secretary for energy and economics, said that creating a policy framework which promotes the right market conditions for renewable energy to flourish were essential for increasing the role of cleaner energy in the power sector globally.

"We've developed the technologies for wind and solar and now we've learnt to use them. It's not even a question of cost anymore it's a question of system integration," Baake said. "We have to create a new market design. Digitalisation will be extremely important as will be integration into the European single market."

BAN CALLS FOR TRANSFORMATIVE APPROACH TO ENERGY

UN Secretary-General Ban Ki-moon urged World Energy Congress delegates that the industry needed to build on the progress already made in driving change in the energy industry to effect a sweeping transformation in their activities and forge closer ties between public and private sectors to achieve this.

The springboard for further progress had been laid by the Paris climate change deal agreed last December, as well as the adoption of the 2030 Agenda for Sustainable Development at the United Nations Sustainable Development Summit in September 2015, he said.

"A transformative approach to energy is critical to success. Achieving our energy goals, including universal access, energy efficiency and renewable energy will open a new world of opportunity and investment," he told WEC 2016 in a video address.

Ban praised the work of the WEC—a UN-accredited body—in moulding the current debate on shifting patterns in the energy sector. "The World Energy Congress is one of the most pre-eminent platforms for action. I commend the World Energy Council for helping shape a sustainability narrative through the Energy Trilemma concept," he said.

The Energy Trilemma lays out three core dimensions, which the WEC says need to be addressed in order to attain energy sustainability: energy security, energy equity—making energy supply more accessible and affordable to more people—and environmental sustainability.

Ban underscored the need for greater efforts to bring together industry with governments and other public bodies.

"Three years ago in a message to the World Energy Congress in Daegu, I called for urgent action to bring the public and private sectors together to advance our collective efforts. Today I urge you to intensify that great work towards a sustainable energy future for the greatest benefits of all," Ban told WEC 2016.

The UN has worked closely with the World Energy Council to promote progress towards achieving the UN's sustainable development "Goal 7", which relates to energy.

Goal 7 targets include ensuring universal access to affordable, reliable and modern energy services by 2030, increasing substantially the share of renewable energy in the global energy mix by 2030, doubling the global rate of improvement in energy efficiency by 2030, enhancing international cooperation and investment to facilitate access to clean energy research and technology, and a focus on expanding infrastructure and upgrading technology to supplying modern energy services in developing countries.

During his term as UN Secretary General, which concludes at the end of December 2016, Ban has been forceful in his belief that achieving Goal 7 targets by 2030 was vital to improving the chances of achieving other UN Global Goals, including those on food security, health care, education, employment and sustainable cities.

He has also stressed that improving access to sustainable and affordable energy in the developing world could save an estimated 4.3 million lives a year, by reducing the number of people using inadequate indoor cooking facilities based on coal, charcoal or animal waste in the developing world.

The challenge for the energy industry now is to speed up its transformation in support of the UN's sustainability agenda over the three years until the next World Energy Congress to be held in Abu Dhabi in 2019.

THE RISE OF AFRICAN RENEWABLE POWER

Energy supplied from renewable sources across Sub-Saharan Africa will soar by nearly 65% between now and 2040, reaching around 585m tonnes of oil equivalent, according to the International Energy Agency (IEA).

The region's power sector will see rapid growth of renewables-based capacity, which will skyrocket from around 20 gigawatts (GW) now to nearly 170GW in 2040. The share of renewables generation capacity in the region's power mix will reach 44% of the total.

Across sub-Saharan Africa, installed solar power capacity increased from 40 megawatts (MW) in 2010 to around 280 MW in 2013. There are several grid-connected projects under construction, including the 155MW Nzema plant in Ghana and 150MW of projects in South Africa. The latter in particular will lead the renewables charge.

It has the second largest economy in Africa and consumes the largest amount of energy, accounting for about 30% of the continent's total primary energy demand— according to BP.

South Africa's renewables sector is the fastest growing in the world, according to Moody's, a ratings agency. In 2015 renewable energy asset finance soared by 300%, from a year earlier, reaching $4.5bn.

Falling costs, a growing number of independent renewable power producers and interest from investors are all helping the renewables sector expand rapidly. Sub-Saharan solar capacity is expected to exceed 6GW by 2020, before soaring to around 45GW in 2040, according to the IEA.

Around half of the region's total solar capacity will then be located in South Africa.

The country will also be the region's biggest contributor to wind capacity additions over the period, adding around 0.3GW per year. Its wind power capacity will reach 2GW by 2020 before soaring to nearly 7GW in 2040—more than half of the sub-Saharan total. Most of this will be located onshore. While South Africa's renewables sector has seen a surge of interest over the past year, coal still provides around three-quarters of its energy needs.

More than 85% of South Africa's installed electricity capacity is powered by coal-fired power stations, according to the Energy Information Administration.

But the government wants to diversify its energy mix by boosting renewable energy capacity and expanding nuclear power, particularly for electricity generation.

The IEA estimates grid-based power generation capacity across the whole of Africa will quadruple between now and 2040, albeit from a very low base of 90GW today.

Half of this growth will be in South Africa.

The government plans to increase its total renewable generating capacity to around 17.8GW by 2030. That's up from just 1.9GW last year.

How fast South Africa's renewables sector actually develops will depend on the pace with which the country's transmission infrastructure, which badly-needs additional capacity, manages to expand. This will depend on interest from investors.

South Africa's electricity system is badly constrained as the margin between peak demand and available supply has been narrowed significantly since 2008. That year some of the country's coal mines had to halt operations because of blackouts.
In 2008 state-run utility company Eskom asked the country's largest industrial customers to cut their consumption by 10% during peak times to avoid unexpected blackouts and scheduled power cuts.

TIME TO INVEST IN AFRICA

Africa needs at least $40bn worth of investment in its energy sector to lift millions of people out of energy poverty and boost economic growth.
Harnessing the continent's renewable energy potential will be a crucial part of the continent's future energy mix, says African Union Energy Commissioner Dr Elham Ibrahim.

"We have our vision for the continent: to have a developed, integrated prosperous Africa driven by its citizens, playing an effective role in the global mix. Energy is the most important element to achieve this," Ibrahim said. "Access to sustainable, affordable and secure energy as a right for everyone across the continent."

Cash required

Last year upstream investment in Africa's oil and gas sector totaled $49bn, according to the International Energy Agency (IEA). This is compared to South America which received around $61bn.
Investment in Africa's downstream and infrastructure was just $8bn last year, the IEA says, compared to around $13bn spent in Latin America's sector. The organisation says around 635m people on the African continent still don't have access to electricity, and average electrification rates are just 43%.
Only 26% of people in rural areas are connected to the grid.
In sub-Saharan Africa the national average figure is just 32%, plunging to around 17% in some rural areas.
Almost 730m people across the continent also still rely on dangerous, inefficient forms of cooking.
In sub-Saharan Africa, investment in electricity access remains "wholly inadequate to eliminate energy poverty", the IEA says, with just 15% of global population and more than half the people without access to power. The region represents only 1.5% of global electricity investment.

Lack of capacity

Over the next two decades the remaining global population without access to electricity is expected to become increasingly concentrated in sub-Saharan Africa, reaching 75% in 2040, compared with around 50% today.
"There isn't enough capacity, there is no technical skills capacity and totally inadequate distribution at country level," Ibrahim said. "Investments are not to the level needed in the sector. These are challenges but at the same time there are opportunities."
She added: "We have energy resources such as coal, oil and renewables but how we can translate these resources to kilowatt hours for the population is our main problem."
Meanwhile the continent's demand for primary energy is expected to increase by over 2% each year between now and 2040.
African energy demand will rise from around 744m tonnes of oil equivalent (toe) in 2013, according to the IEA, to 1.3bn toe.
Ibrahim said the oil price crash since 2014 has demonstrated the importance of Africa diversifying its energy mix. "I remember 15 years ago I was in a forum with a Saudi Arabian representative who was against renewable energy and he asked why we need to invest in renewable energy when his country has so much oil.
Now we can see why," Ibrahim said. "That's why we're encouraging to have a mixed energy pool. And that's why I congratulate what the United Arab Emirates are doing."
Over the past two years Brent prices have fallen, from over $94/b in mid-October 2014, down to around $53/b at the same time this year.
Ibrahim said that while the market has had an impact on investment globally, Africa has been particularly hard hit.
"In Africa we have all the energy resources we need. We can use coal, gas and renewables. What we need now is investment," Ibrahim said. "To make that happen we need policies, regulations, transparency and of course political stability is crucial."

GETTING THE PUBLIC-PRIVATE FINANCE BALANCE RIGHT

De-risking investment in low carbon technologies is easier said than done, requiring a careful balance between public support and private finance, WEC 2016 delegates were told on Wednesday.

One of the biggest blocks to large-scale private investment in renewable energy has been uncertainty over the scale and duration of government policy, Jeroen Van der Veer, chairman of WEC's Supervisory Board, and the executive chair of Financing Resilient Energy Infrastructure at the ING financial group.
He said the risk that subsidies could be withdrawn in three or four years' time meant that projects, which often needed to be highly leveraged in the first place, had difficulty attracting backing.

The situation has been compounded by over-enthusiastic government support in some countries, designed to speed up the transition to renewable energy, but without the financial resources to maintain momentum. For example, both Germany and Spain's solar and wind energy frameworks have suffered as a result of attractive but short-lived availability of cheap feed-in tariff rates for renewables. These triggered a spate of construction followed by a collapse in the market.

A more gradual, but sustainable process was needed, panellists at the WEC session said, adding that a carbon tax or carbon pricing would need to be adopted on a much wider scale than has been the case so far—a process likely to fraught with political and implementation difficulties.

Tom Delay, chief executive of the UK based Carbon Trust, which advises companies around the world on green strategies, said large-scale renewable projects had more chance of success if governments and project leaders devised comprehensive plans before seeking finance.

He said that uncertainties over issues such as the availability of grid connections and possible planning permission delays could be removed before a project got under way, that project could effectively be de-risked, making it much more attractive to investors.

Despite the clarity this would provide for the investment community, it was still quite rare for such comprehensive plans to be drawn up.

Given the pace of technological change now sweeping the low carbon energy industry and, in particular, the falling price of that technology, more investment is still likely to be attracted to the sector, even with the relatively high risk.

However, investment in renewables has slumped this year from 2015 levels. Even though investment last year was at record levels, the fall may still be a worry for clean energy industry. However, this is no reason for complacency in the fossil fuels industry, where investment has also slumped. Delay said he had great faith in disruptive innovation, which has been a clear factor in the paths charted in many sectors. "Why would the energy market be any different?" he said.

The falling cost and growing capacity of energy storage solutions could be one such disruptive technology, as could carbon capture and storage (CCS). However the latter would require either governments, the fossil fuel industry—or both—to invest heavily up front in developing the technology.

That's something that has been rare on either side, so far.

Delay estimates that a carbon price of $100 per tonne or more would be needed to make CCS attractive to investors. But few believe that if a carbon price does come into effect that is designed to make a difference to the overall green investment climate it would be greater than around $40/t.
He says the onus is on the fossil fuel industry to lead the way on CCS, if it wants to safeguard its future by becoming regarded as a clean energy source.

ENERGY GETS SMARTER

Global energy demand per capita will peak before 2030 as technological innovation and government policies will drive efficiency increases, Nuri Demirdoven, Managing Director of Accenture Strategy Energy told delegates.

Rapid digitalisation in the end user utility sector and upstream will also be a key driving force in increasing both energy efficiency, Demirdoven said.

This is in stark contrast to historic global growth levels, which have seen global demand for energy more than double since 1970.

"Demand per capita is peaking but absolute energy demand is still increasing because of (increased) productivity and a rising population," Demirdoven said.

"What's changing is how we're meeting that demand and the mix is changing. With electrification of our homes, they are getting smarter."

Accenture Strategy has developed a set of global energy demand projections alongside the World Energy Council. These scenarios: Unfinished Symphony, Modern Jazz and Hard Rock, differ depending on the impact of energy market evolution and the extent to which regional cooperation is achieved to mitigate the effects of climate change.

The Modern Jazz scenario is a forecast based on assumptions that global energy demand increases will be driven by the economy.

"In this, we're using solar panels because they're cheaper than the alternatives," Demirdoven said. "We're using electric vehicles because we as consumers believe they're more beneficial to us from a cost perspective. In this one there's electricity for all. Because the market makes it happen."

The Unfinished Symphony scenario is a forecast which assumes greater international coordination and a bigger role for government to reach carbon reduction goals.

The Hard Rock scenario assumes local energy needs are prioritised over global ones, resulting in higher use of fossil fuels. The scenarios forecast an ongoing shift in final energy consumption with demand for electricity doubling by 2060. This will be partly driven by a tripling of the global light duty vehicle fleet, Demirdoven said, and increased use of electric vehicles within it.

Renewable power will also see significant gains in the global energy mix over the next few decades. Solar and wind, which today account for around 4% of power generation globally, will experience the largest increase over the five decades. By 2060 the two renewable fuels will account for between 20% and 39% of power generation globally.

Meanwhile fossil fuel usage could fall to as little as 50% of the total, global primary energy mix, according to one of the report's scenarios.

Despite this, the world's carbon budget will be exceeded within the next 30 to 40 years, Demirdoven said.

In all three scenarios global gas demand will rise, Demirdoven said whereas growth in global liquids demand will start to fall from 2030.

"Historically we've seen (global liquids demand) increases of 0.8m b/d per year," Demirdoven said. "In Unfinished Symphony, which is the most interventionist scenario, we see a 0.5m b/d per year increase."

Across all three scenarios fossil fuels will remain the mainstay provider of global energy demand for decades to come, particularly in the transport sector.

KEEP IT SIMPLE, STUPID; GO FOR NET ZERO EMISSIONS

Phillipe Joubert, senior advisor and special envoy for energy and climate for the World Business Council for Sustainable Development (WBCSD)

Since the signing of the Paris Agreement at COP21, I have been invited to several global events to discuss the text and its impact on business. I have noticed that when it cornes to defining the targets for busi-ness, the largest focus is generally on Article 2: "the increase in the global average temperature to below two degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 degrees Celsius."

A lot of discussions are based around this statement, looking at the real effect on `such and such' measures, timing issues, the cross-implications of different measures on each other, challenging the baseline chosen to calculate the increase etc.

Some companies are even now writing a so-called two degrees Celsius strategy based on the reduction of emissions compared to business as usual. As if business as usual was still possible and desirable. They rightly speak about transition, but in lengthy terms unfortunately not adapted to the urgency expressed by climate change science.

We are carbon addicts so we are discussing how to overcome our addiction, in a mature way, trying to avoid too much suffering.However we seem to refuse to see the obvious; we are facing a huge transformation of our development model, not Kaizen type progress, and, there will be winners and losers. However, the losers have immense strength and lobbying power. We are in fact in denial of the necessity of change, in deniai of our own withdrawal syndrome, as if the danger of not making this deep change was not existential.

Instead of Article 2 we should be focussing on Article 4, which states "...to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century." In plain English, getting to "net zero emissions" between 2050 and 2100.
Having led several turn-arounds, some of mufti-billion companies with tens of thousand of people around the globe, I know that communicating in a clear and simple way is the first key success factor of a turn around.

We have run out of time to discuss the target, what we should agree immediately on now is its concrete implementation. The negotiators of the Paris agreement have shown the way in Article 4.
It is a clear, understandable, undisputable way to "zero net emissions". We must stop losing time on refining the target and procrastinating, instead we must now go for it. From the US Navy's KISS (‘Keep It Simple, Stupid') design principle in the 1960s, simplicity is often at the centre of management theory.

Zero tolerance was once used by New York Mayor Rudy Giuliani, and has been described as the real key to success in a much lighter challenge, so why not use this simplicity to fight for our civilisations survival?
In our case, although there are different interpretations, everyone understands the baseline that 'net zero' aims for. This is a suitable way, within this kind of complex issue, to rnotivate and align internally and externally all the stakeholders around a simple but powerful idea.

We need to focus on a course of action and not to come back to endless discussions about impact, measurements, why me and not another person or organisation, etc.

There is no contradiction whatsoever between striving to be below two degree Celsius and net zero emissions except one; net zero is simple and actionable, the other is a collective consequence, but nota business goal.

Organisations that see this already are those associated with the B Team for example, where the two go hand in hand; "Achieving the transition to a thriving and just Net-Zero greenhouse-gas emissions

economy by 2050 is the best way to operationalize the long-terrn goal of maintaining the temperature under the 2°C of warning threshold." This is already more ambitious and clearer than the Paris text, targeting the middle of this century, rather than somewhere in the second half.

Last year, Unilever's CEO Paul Polman, B Team member and Chair of VVBCSD, called on business leaders to join in: "A target of net-zero emissions by 2050 is not only desirable but necessary. This is the time to redouble our efforts and further accelerate progress to decarbonise our economy. This is not going to be easy, but the earlier we act, the greater the economic opportunities will be."

Some organisations such as IKEA are well on their way, with a goal to be 100% renewable by 2020; producing as much renewable energy as they consume. That commitment to 100% renewable power is gaining support thanks to the RE100 initiative. Shell has now moved ahead of the curve going from a two degree scenario to anew pathway to net zero emissions. Chad Holliday Chair of Shell and former Chair of WBCSD was in Singapore two weeks ago to present this work.

We must now change the speed and dimension of our actions — choosing this clear way is the first necessary decision to make. We should not choose procrastina-tion and complexity again but now go for a simple meaningfill target; zero, nil, nada, niente, rien. Get rid of GHG emissions, stop discussing and just do it.

BETTER BY DESIGN?

The rapid scale of change in Europe's energy market poses complex challenges for regulators, policy makers, producers and consumers. The advance of renewable energy asks questions of what the right back-up power system would look like. And in many markets, said Norbert Schwieters, Global Energy, Utilities and Mining Leader, PWC, chair of the panel session on European electricity market harmonisation and the role of market designs yesterday, cleaner fuels has yet to make inroads. "In Germany, coal is the fuel of choice in the fossil fuel area, not natural gas."

By 2030, Europe will have 50 percent of its power market from renewable energies, forecast Patrick Graichen, Executive Director at German think tank Agora Energiewende, up from about 29 percent now. "The biofuels story is over," he said.
A modeling exercise undertaken by Agora found that wind and solar will have the most crucial role to play as the cheapest of renewable energies.
The EU's overall renewables target of 27 percent by 2030 will largely be delivered by the power sector, as biofuels and renewable heating sources are limited.
The biggest pain will be borne by the coal sector. "There's no other way than phasing out coal. It is very clear it needs two-thirds less coal use by 2030 compared to 2010 in order to get to the EU's carbon emissions reduction targets. And that means about half of the coal plants in Europe will be shut down in the next 15 years," said Graichen.

There is also a pressing need for more flexibility in the power sector. Increasing versatility in the system should go hand in hand with the growing share of variable renewable energy sources. Greater flexibility, agued Graichen, would mean 40 percent less investment required. "The question is what is the right market design for such a world? Textbook economics tells us that an emissions trading system (ETS) that deals with CO_2 — and with a liberalised energy market with marginal pricing at wholesale power market — means the rest will take care of itself. But the real world situation is different. There's no ETS that delivers the social cost of carbon. So we will always have some capacity instrument to back up that situation otherwise there will be blackouts."

Dalius Misiùnas, CEO of Lithuania's Lietuvos Energija, highlighted his country's experience in electricity interconnection. "We import most of our power, so we trust the market. But there are three things that are needed to make the market function. First, infrastructure, second, platforms and third, rules." Despite the recent talk of supergrids carrying power fines to transport solar power from south to north, and wind power from north to south, Misiûnas doubted whether these could happen in practice. On the platform issue, this has largely been resolved. The biggest drag on progress is on rules, said Misiùnas. "It's difficult to get results at the regional or European level, and that is because of national aspects. Every European member state thinks of energy as a matter of national security. That's a reality," he said.
Misiûnas warned against subsidy tourism. "Investment is going after subsidies. Hopefully it will reduce, but national regulations on support mechanism for renewables are what is stopping us.'

Fintan Slye, CEO of Ireland's EirGrid, flagged up how different market structures are shaping things. "There are three elements that need to be in place to for market design to deliver outcomes desired by the Paris commitment on decarbonisation'.

First, there must be a clear vision about what market design is doing, looking at regulation, targets and geographies. Second, market design must recognise and reward the dynamics of a market that has a large amount of renewables in it. "That market must have flexible capacity," said Slye. "One of the things Ireland has learned is that because of it's small synchronous system is that you need core system services to ensure it stays stable at high levels of renewables.

Lastly, there is need for market design to encourage innovation. "The scale of disruption that is going to come from technology is substantial. So far we've only nibbled around the edges. But the speed and pace of disruptive technological innovation will turn the market on its head," said Slye.

LA GESTION DES CYBER-RISQUES

LE CHEMIN VERS LA RÉSILIENCE - GESTION DES CYBER-RISQUES

The aggressive nature of cyber threats – and the potential that an attack crosses from the cyber realm to the physical world – requires the energy sector to reconsider how it views and addresses cyber risks. 'The road to resilience – Managing cyber risks' is the third report in the series about Financing Resilient Energy Infrastructure. This third report investigates how cyber risks can best be managed, taking into account the changing nature of the energy industry and energy infrastructure. Actions are recommended for decision makers and stakeholders to improve the sector's response to rising cyber threats, as part of a wider move toward greater resilience.

Greater resilience to cyber risks of energy systems is crucial for energy security. Increased digitisation lead to more efficiency and opportunities for grid and pipeline management and exploration and production activities. Yet, at the same time energy assets become more vulnerable to cyber-attacks, in particular due to the automation of Industrial Control Systems (ICS). Attacks on ICSs could lead to loss of control of key equipment, with potential machinery breakdown, fire, explosion or injuries.

The series of reports is prepared with Swiss Re Corporate Solutions and Marsh & McLennan Companies with insights from the European Bank for Reconstruction and Development.

La nature agressive des menaces cybernétiques - et le risque qu'une attaque passe du cyber-royaume au monde physique - oblige le secteur de l'énergie à reconsidérer comment il envisage et s'attaque aux cyber-risques. « Le chemin vers la résilience – La gestion des cyber-risques » est le troisième rapport de la série sur le financement des infrastructures énergétiques résilientes. Ce troisième rapport étudie la manière de gérer au mieux les cyber-risques en tenant compte de la nature changeante de l'industrie énergétique et des infrastructures énergétiques. Des mesures sont recommandées aux décideurs et aux parties prenantes pour améliorer la réponse du secteur aux menaces cybernétiques croissantes, dans le cadre d'un mouvement plus large vers une plus grande résilience.

Une plus grande résilience aux risques informatiques des systèmes énergétiques est cruciale pour la sécurité énergétique. Une numérisation accrue entraîne une plus grande efficacité et des possibilités de gestion du réseau et des oléoducs ainsi que des activités d'exploration et de production. Pourtant, en même temps, les actifs énergétiques deviennent plus vulnérables aux cyberattaques, notamment en raison de l'automatisation des systèmes de contrôle industriels (ICS). Les attaques sur les ICS pourraient conduire à la perte de contrôle de l'équipement clé, avec une défaillance potentielle de la machine, un incendie, une explosion ou des blessures.

La série de rapports est préparée avec Swiss Re Corporate Solutions et Marsh & McLennan Companies, avec des informations de la Banque européenne pour la reconstruction et le développement.

Synthèse et rapport disponibles sur : http://wec-france.org/etudes.php

Parole aux jeunes

Cette partie est diffusée telle que rédigée par les jeunes sans modification du Conseil Français de l'Énergie.

LA PAROLE AUX JEUNES

De gauche à droite : Audrey Berry, Marie Petitet, Alena Kotelnikova, Xavier Lambin

Audrey Berry, Ingénieur, Doctorante en économie de l'énergie

Audrey prépare un doctorat en économie au CIRED. Elle s'intéresse aux impacts sociaux de la transition vers une société sobre en carbone. Ses travaux portent plus particulièrement sur la vulnérabilité des ménages français face à une hausse des prix de l'énergie. De formation ingénieur Supélec et économiste TSE, elle a auparavant travaillé dans les réseaux électriques intelligents pour l'Ademe.

Marie Petitet, Ingénieur, Doctorante en économie de l'énergie

Diplômée de l'ENSTA-ParisTech, Marie Petitet termine son doctorat à l'Université Paris-Dauphine et à RTE (Département Marchés). Son sujet de thèse porte sur la coordination de long-terme des investissements dans la production électrique. L'étude s'inscrit dans le contexte de la transition énergétique soulevant une problématique double : celle du développement des énergies renouvelables et celle de l'adéquation de capacité de production.

Alena Kotelnikova, Ingénieur, Docteur en économie de l'énergie

Passionnée par la transition énergétique, ses travaux portent sur la décarbonisation du secteur des transports, et en particulier sur le cadre économique et politique propice au développement de la mobilité zéro émission. Pendant sa thèse à l'Ecole Polytechnique, elle a aussi travaillé chez Air Liquide à définir la stratégie de déploiement de la mobilité hydrogène. Alena est désormais économiste de l'énergie chez Air Liquide.

Xavier Lambin, Ingénieur, Doctorant en économie de l'énergie

Xavier effectue un doctorat en économie de l'énergie à la Toulouse School Of Economics et ENGIE. Ses travaux portent sur les problématiques d'investissement dans le secteur de l'électricité et la régulation des marchés. Il s'intéresse aussi aux nouvelles structures de marchés, tels que les marchés bifaces. Diplomé de l'Ecole polytechnique, Xavier était auparavant consultant sur les marchés du gaz en Europe.

Nous remercions tout particulièrement Jean Eudes Moncomble et les membres du CFE pour nous avoir permis de vivre cette expérience enrichissante.

1. INTRODUCTION

Après Daegu, le 23e Congrès Mondial de l'Énergie s'est déroulé à Istanbul, en Turquie. Pour cette occasion, le Conseil Mondial de l'Énergie (CME) a dévoilé ses nouveaux scénarios énergétiques pour le futur, qui ont été débattus par les acteurs présents. En parallèle, les pays voisins, largement représentés, ont initié des discussions sur les enjeux du pétrole au Moyen-Orient dans le contexte de la transition énergétique et du prix actuellement bas du pétrole. Le pic de la demande par habitant est devenu la nouvelle métrique, qui remplace l'ancienne notion de pic de production pétrolière. La production n'est plus conditionnée par la disponibilité du pétrole, mais par la demande, dont la valeur par habitant devrait atteindre un plafond d'ici 2030 d'après les dernières études du CME. Le défi démographique, en particulier de la Chine et de l'Inde, soulève des questions pour l'approvisionnement en énergie, notamment pour le transport, où les alternatives au pétrole restent à développer. Pour relever ces défis, les représentants de l'industrie ont appelé les Etats à la mise en place d'un contexte financier favorable à l'innovation privée.

Les énergies nouvelles ont été l'un des principaux sujets discutés pendant le Congrès, en particulier par les grands pétroliers qui cherchent à diversifier leur production d'électricité. Le CME annonce un doublement de la demande d'électricité d'ici 2060 avec l'électrification des pays émergents et de l'industrie du transport. La décarbonation du transport est mise en avant comme un obstacle majeur à surmonter. Enfin, la réussite de la Grande Transition devrait s'appuyer sur quatre facteurs clés : la lutte contre le changement climatique, la résolution du trilemme énergétique, l'accès à l'énergie pour tous et la collaboration entre les acteurs pour encourager les partenariats publics-privés.

Le site du Congrès à Istanbul

2. LE 23e CONGRÈS MONDIAL DE L'ÉNERGIE, "EMBRACING NEW FRONTIERS"

JOUR 1 : LA MISE EN MUSIQUE DU FUTUR

Le premier temps fort du congrès a été l'annonce des nouveaux scénarios prospectifs du CME. Ces scénarios se caractérisent par des modes de coordination différents : par le marché pour le scénario "modern jazz", par les politiques gouvernementales pour le scénario "unfinished symphony" ou par des initiatives locales pour le scénario "hard rock". Cet exercice prospectif de type bottom-up montre qu'une action coordonnée des états peut permettre l'atteinte des objectifs environnementaux les plus ambitieux.

L'aspect géopolitique du congrès a pris tout son sens avec la participation de cinq présidents qui ont proposé leurs visions pour l'énergie. Il ressort que l'énergie a les moyens de devenir un vecteur d'entente, de coopération et de paix, plutôt qu'une source de conflit.

JOUR 2 : ORCHESTRER LES NOUVEAUX MARCHÉS

Les business models innovants ont été discutés lors de la deuxième journée. Le secteur énergétique fait face à plusieurs défis, résumés par BP sous les "3C" : compétitivité, carbone et choix. Plus précisément, le choix d'un projet d'investissement se doit être robuste à des prix bas de l'énergie et aux objectifs bas carbone. Au cours des sessions, différentes solutions ont été présentées et discutées : énergies décentralisées, innovations urbaines, solutions tournées vers le consommateur, etc.

Les échanges ont également portés sur la géopolitique des ressources fossiles. Nous avons pu observer les efforts de l'OPEP pour assurer la coopération entre ses membres, tout en ouvrant au dialogue avec les pays non-OPEP. Si la volatilité est une réalité qui fait consensus, l'attitude à adopter pour y faire face fait débat. Total défend une vision très pro-marché, avec un prix fixé par l'offre et la demande, quand l'OPEP prône une action plus directe sur l'offre.

JOUR 3 : UN RYTHME TERNAIRE POUR LA TRANSITION

La troisième journée du Congrès était dédiée à la discussion du trilemme énergétique. La transition énergétique devrait permettre d'assurer la sécurité énergétique, l'équité d'accès à l'énergie et le respect de l'environnement. Le CME a développé un index avec des critères quantitatifs pour évaluer les trois dimensions de ce trilemme. En suivant cette démarche, 125 pays ont été classés. Il en ressort une forte disparité entre les zones géographiques. Si 9 des 10 pays les mieux classés sont européens, on observe un problème d'accès à l'énergie pour la majorité des pays africains (subsahariens en particulier).

Les thématiques évoquées au cours de la journée étaient plus larges que les deux jours précédents. En particulier, les liens avec l'alimentation, l'accès à l'eau potable, la pollution de l'air ont été discutés. La question d'attirer les financements nécessaires à la transition s'est révélée comme une dimension cruciale. Les investisseurs privés réaffirment le besoin de garanties sur le long terme.

JOUR 4 : AFRIQUE, LE RYTHME S'ACCELÈRE

La dernière journée du Congrès a été consacrée à l'Afrique. Au niveau mondial, il apparaît que les ressources énergétiques ne sont pas équitablement réparties entre les pays. Cette constatation est très marquée pour l'Afrique. Face à cela, il est alors nécessaire de mettre en place une coopération régionale, comme essaie de le faire la CEDEAO pour l'Afrique de l'Ouest. Le défi démographique, le manque de transparence dans l'accès à l'information et la gouvernance sont également des enjeux à concilier avec celui de la transition énergétique.

Le congrès s'est clôturé par l'intervention des membres des CME de différents pays, qui ont résumé les sujets débattus lors de ces quatre journées. Les Future Energy Leader ont aussi proposé leur vision des capacités clés que les jeunes de demain devront acquérir pour la réussite de la transition énergétique : courage, savoir et patience.

Les trois scénarios dévoilés au cours du WEC

3. LES MESSAGES DU CONGRÈS

Le congrès a réunis de nombreux intervenants présentant des messages touchant des sujets très divers. À nous quatre, voici le principal message que nous souhaitons faire ressortir :

Les grands défis énergétiques et environnementaux de demain nécessiteront la mise en place d'une régulation restant à inventer, dans un monde détenant encore des ressources pétrolières considérables !

LES GRANDS DÉFIS ÉNERGÉTIQUES ET ENVIRONNEMENTAUX DE DEMAIN ...

L'organisation de la résilience

Il est crucial de diversifier nos sources d'énergie pour faire face aux phénomènes climatiques extrêmes. C'est ce qu'ont rappelé les acteurs sud-américains lors de la session "The Road to Resilience". Leur électricité est aujourd'hui majoritairement hydraulique. Face aux sécheresses qui s'accentuent, ils ont souligné l'urgence d'investir dans de nouvelles sources d'énergies et ont appelé à plus d'intégration régionale. D'autres pistes d'amélioration sont évoquées : le rôle des assurances, l'amélioration des modèles météorologiques, la décentralisation de la production, etc. Le problème des pénuries d'eau va en fait au-delà du secteur énergétique, si bien que l'optimisation de la gestion de la ressource en eau devra être systémique et intégrer les utilisations concurrentes que sont l'eau potable et l'irrigation. Afin de relever les défis en matière de résilience, l'accès aux financements, en particulier les financements de long-terme, reste trop faible par rapport aux besoins. Il s'agit, pour la communauté internationale, d'identifier de nouveaux mécanismes favorisant les investissements de long-terme, par définition les plus à même de préparer le futur.

La route vers le futur de la mobilité

Le panel constitué d'académiques, d'industriels et de représentants de l'État s'est accordé sur le fait que le futur de la mobilité est électrique. Le déploiement progressif des véhicules électriques à batterie (BEV), couplé avec l'intégration systémique des énergies renouvelables, permettra de décarboner intelligemment le secteur du transport qui est le deuxième plus grand émetteur de gaz à effet de serre. Néanmoins, il a été souligné que la batterie ne représente pas l'unique option de stockage et que le stockage hydraulique et sous forme d'hydrogène ont un rôle important à jouer dans la gestion du stockage de moyen et long termes des énergies intermittentes. Le rôle important de l'État est reconnu à l'unanimité par l'ensemble des intervenants pour soutenir des phases initiales de déploiement. Il faudra encore probablement définir l'évolution des politiques une fois que les BEV auront atteint le point de compétitivité avec les véhicules à l'essence : la taxation éventuelle de l'électricité serait-elle appliquée à la recharge ou à l'achat de véhicule ?

Un futur vert mais efficace énergétiquement ?

La transition énergétique est en marche mais différentes options restent ouvertes. Pour réduire les émissions de CO_2, qu'allons-nous préférer ? Lorsque certains défendent la solution par l'offre, basée sur des énergies renouvelables, d'autres proposent également d'optimiser notre façon de consommer et de produire en augmentant notre efficacité énergétique. Les deux options se traduisent par des solutions techniques qui semblent bénéficier d'une maturité économique suffisante à leur développement. Cependant, en pratique, le concept d'efficacité énergétique reste flou et complexe à chiffrer, d'où une forte réticence des investisseurs financiers. Au contraire, les projets renouvelables bénéficient du soutien des banques. Il s'agit alors d'être innovants pour améliorer l'image de l'efficacité énergétique et attirer des capitaux. Une issue possible pourraient consister en une vision globale via des projets intégrant une triple dimension renouvelables / efficacité énergétique / stockage, comme proposée par l'AIE notamment pour les zones rurales avec peu d'accès à l'énergie.

Renouvelables : du défi technologique à l'intégration au système

Le rôle des énergies renouvelables ne soulève plus de débat dans le secteur énergétique. Plus particulièrement, les intervenants de la session « Global renewables update : The reality of scaling up » ont insisté sur la participation déjà effective des renouvelables dans la transition énergétique. La maturité technico-économique est atteinte, même si les coûts pourraient encore diminuer sous l'effet de la concurrence. Le défi actuel devient la mise en place d'une meilleure intégration des renouvelables intermittentes dans le système électrique : Signaux nécessaires aux investissements dans des capacités de back-up, mécanismes de court terme, etc.

L'annonce du classement des pays selon l'index du trilemme

… NÉCESSITERONT LA MISE EN PLACE D'UNE RÉGULATION RESTANT À INVENTER …

Comment financer la Grande Transition ?

Le financement de la transition énergétique nécessite un investissement important (de l'ordre de la moitié de PIB mondial) ainsi qu'une collaboration forte entre les acteurs publics et privés. Il existe de nombreux exemples de mécanisme de financement : le marché des green bonds de la BEI ; le récent abattement des subventions pour les énergies fossiles au Maroc ; ou le prix implicite du carbone dans certains secteurs. Les mécanismes de soutien doivent tenir compte du contexte régional. Ainsi le prix du carbone n'est pas forcément adapté au marché asiatique où, en plus de la décarbonation du mix énergétique, le gouvernement cherche à mettre en place des solutions peu coûteuses pour la population qui n'a pas encore accès à l'énergie. Des enjeux plus globaux d'aujourd'hui sont l'élaboration du cadre pour encourager des investissements privés bas carbone et l'intégration des performances environnementales dans l'estimation de la banquabilité des projets.

Quel futur pour le secteur électrique en Europe ?

Les évolutions et l'harmonisation des marchés électriques européens continuent de faire débat. En particulier, les participants s'inquiètent de l'adaptation des capacités thermiques existantes à l'introduction des énergies renouvelables avec des coûts variables très faibles. Si les mécanismes de capacité s'imposent dans la plupart des cas comme une réponse envisageable, il ne faut pas oublier que les signaux d'investissement devraient inciter à des choix cohérents avec les objectifs environnementaux. Dans cette perspective, un prix du carbone suffisant doit être mis en place. Cela est d'autant plus urgent dans le contexte actuel où le charbon est utilisé avant les centrales au gaz, du fait des prix relatifs de leurs combustibles. Agora Energiewende suggère qu'un prix de 60€/tCO_2 fournirait les bonnes incitations pour le secteur électrique européen et insiste sur la nécessité de le mettre en place avant de se décider quant aux mécanismes de capacité. Les initiatives anglaise et française pour la mise en place d'un prix plancher semblent alors un premier pas dans cette direction. Cependant, quand les investisseurs continuent de défendre la nécessité de garanties de long-terme, il est urgent de s'assurer que l'architecture de marché puisse déclencher les investissements suffisants dans le long-terme, tout en permettant l'utilisation des capacités existantes de façon à limiter les émissions de gaz à effet de serre.

La subvention pour les renouvelables : une arme à double tranchant ?

La nécessité du soutien public au début du déploiement des énergies renouvelables est largement reconnue par les différentes parties prenantes. Un des instruments de soutien politique souvent utilisé est la subvention. D'un côté, la subvention cherche à encourager l'investissement en réduisant la différence de coûts entre une technologie verte et son concurrent fossil, et en la rendant plus compétitive. D'autre part, la subvention entraîne un sérieux risque politique qui décourage les investisseurs privés. En effet, les subventions ne sont pas faciles à mettre en place et n'arrivent pas forcément à suivre le rythme de déploiement rapide des renouvelables. Ainsi, cela augmente la dette existante de l'État qui est en conséquence obligé de changer la réglementation en cours de route. Lequel des deux effets dominera le marché français à moyen et long terme ?

Attaquer le risque réglementaire à la source

Les entreprises, très présentes au sein du congrès, déplorent à raison un climat d'investissement risqué. Des mesures sont demandées aux politiques afin de sécuriser l'investissement. Une fois ces mesures en place, on dénonce un risque réglementaire –ces mesures vont-elle être perpétuées ?

Les entreprises traditionnelles semblent continuer à s'adresser en particulier à un interlocuteur qu'elles connaissent bien -- trop, diront certains : les politiques. Mais ceux-ci répondent aux besoins de l'électeur. S'assurer de leur soutien pérenne, et leur faire comprendre l'intérêt de ces mesures

assurerait sûrement davantage de continuité réglementaire. Étonnamment, les nouveaux modèles des start-ups ou des coopératives (moins présentes au congrès), en s'adressant directement à leurs consommateurs et en s'assurant de leur engagement, évoluent peut-être dans un environnement moins risqué.

La méthodologie des scénarios selon Ged Davis (Chair of the World Energy Scenario Study Group)

… DANS UN MONDE DÉTENANT ENCORE DES RESSOURCES PÉTROLIÈRES CONSIDÉRABLES !

Budget carbone : le grand absent des discours

Si l'importance de lutter contre le changement climatique a été maintes fois rappelée au cours de cette première journée, réduire la production à partir des énergies fossiles ne semble pas (encore) à l'ordre du jour. Aujourd'hui, le pic énergétique ne fait plus référence à la production de pétrole mais à la consommation d'énergie par habitant (qui devrait atteindre son maximum d'ici 2030). Autrement dit, nous vivons dans un monde où il n'y aurait pas de contrainte sur les ressources fossiles, si bien que leur maintien dans le mix énergétique n'a pas été questionné par les différents intervenants. Mais qu'en est-il du budget carbone pour maintenir le réchauffement climatique sous les 2°C ? Au rythme actuel, nous l'aurons épuisé d'ici 20 ans. Des politiques plus ambitieuses semblent clairement nécessaires pour parvenir aux objectifs fixés par l'Accord de Paris sur le climat.

La sémantique d'un cartel

Le ministre saoudien de l'énergie, Khalid al-Falih a tenu à souligner le caractère structurant de l'OPEP sur les marchés. Il a exprimé son optimisme vis-à-vis d'un accord de l'OPEP en novembre qui fournirait un meilleur climat d'investissement. Les présidents Vladimir Poutine, et Nicholas Maduro ont par la suite exprimé leur soutien aux mesures de limitation de la production. Ce fut l'occasion d'apprécier la subtilité des éléments de langage choisis par le ministre : il ne s'agit pas de contrôler la production pour augmenter les prix, mais bien d'aider le marché à s'ajuster. Un « subtil toucher de volant » afin de « stabiliser le marché » et protéger les consommateurs des chocs de prix. Si la

sémantique s'adapte bien aux discours politiques d'un royaume dont les revenus pétroliers représentent 40 % du PIB, le langage des économistes est généralement plus direct !

La confiance des consommateurs est aussi une ressource rare

La catastrophe de Deepwater Horizon n'a pas eu pour seule conséquence le paiement d'une amende record. Elle a aussi gravement atteint la confiance des consommateurs en BP. Son PDG a souligné dans la session d'ouverture que des efforts considérables avaient été déployés en vue de la regagner. Dans un autre registre, la session traitant des attaques informatiques des infrastructures et des données a montré l'importance de la confiance qu'accordait le consommateur à ses fournisseurs d'énergie. À nouveau, cette confiance est très dure à gagner, et s'évanouirait à la moindre défaillance. Nous passons d'un monde de l'énergie où le consommateur était passif – presque inexistant -- à un monde où il est acteur du marché et exerce des choix : la confiance des consommateurs semble être une nouvelle ressource rare, que les entreprises vont devoir apprendre à gérer.

Désinvestir pour mieux investir

Accélérer la transition énergétique requiert d'importants investissements. Pourtant, ce ne sont pas les solutions de financement qui manquent. L'une d'entre elles consiste à réduire les investissements réalisés dans les énergies fossiles afin d'augmenter ceux effectués dans les énergies renouvelables et l'efficacité énergétique. Les intervenants de la session sur le désinvestissement ont souligné qu'une entrave majeure réside dans les risques associés à l'adoption de nouvelles technologies. Ils appellent à des signaux clairs des gouvernements : des signaux qui reflètent la raréfaction des ressources fossiles et qui encouragent entreprises et investisseurs à oser et innover. D'autres ont soulevé que les ressources sont aujourd'hui inefficacement utilisées et que les entreprises pourraient davantage diversifier leurs portfolios. Sans ces changements majeurs, on peut se demander quels seront les risques - financiers, environnementaux et sociaux - de continuer à largement investir dans les énergies fossiles.

Session parallèle sur "To invest or to divest"

ET L'AFRIQUE ?

Financement du déploiement d'énergie en Afrique

L'électrification de l'Afrique représente un défi ambitieux pour le gouvernement et une opportunité unique pour les entrepreneurs. Les acteurs comme Bboxx proposent déjà des solutions d'accès à l'énergie propre et décentralisée clé en main : des PV, des batteries de stockage, et des appareils électroménagers réunis dans un seul système. Le prix du service est comparable à ceux de la solution classique qui inclut du kérosène, des bougies et des piles. Le prix compétitif est assuré en minimisant le coût d'entretien des installations par la gestion des données en temps réel qui sont accessibles grâce aux paiements par téléphone portable. Les investissements privés doivent être soutenus par l'action gouvernementale qui doit mettre en place un cadre régulatoire stable et transparent. Le besoin en financement additionnel par les banques de développement spécifiquement dédiées au contexte africain est également évoqué.

Engager la population africaine dans la transition énergétique

L'Afrique a enclenché sa transition énergétique. Initialement très carbonés de par leur exploitation du pétrole, l'Arabie Saoudite et les Émirats affichent des objectifs environnementaux ambitieux, avec des projets solaires et nucléaires notamment. Cependant, pour une grande majorité des africains, l'enjeu n'est pas une transition mais tout simplement un accès à l'énergie et en particulier à l'électricité.

Si l'ensemble des intervenants exprime la nécessité de développer des partenariats public-privé, certains suggèrent que la transition énergétique africaine ne pourra se faire efficacement sans un engagement fort des populations locales. Barefoot College, qui développe une initiative innovante de formation en électrification solaire à destination de femmes illettrées en milieu rural, résume cette idée par le concept de « people – public – private partnership ». De plus, puisque l'énergie constitue rarement un bien final, l'engagement des populations doit également passer par l'écoute des besoins à une échelle locale afin d'assurer la pertinence des solutions mises en place. Enfin, encore plus que dans le reste du monde, la réflexion énergétique en Afrique doit être en relation avec les grands enjeux du continent : l'accès à l'eau, la nutrition, la santé et la protection de l'environnement.

L'Afrique, laboratoire pour l'innovation

Cette dernière journée a exposé de nombreuses perspectives enthousiasmantes pour ce continent qui a été décrit comme le « futur de l'énergie ». Si l'Afrique rencontre de nombreuses difficultés, notamment en termes de précarité énergétique ou d'intégration régionale, il est rassurant de voir que certaines initiatives privées, notamment les solutions décentralisées proposées par Mobisol, ou M-kopa (présents au congrès) rencontrent un important succès. Ces initiatives innovantes proposent des solutions commercialement viables, tout en participant au développement de zones reculées. Le congrès a illustré que les gouvernements ne peuvent pas tout. Lorsqu'ils sont impuissants, le secteur privé peut apporter des solutions. Ces projets comportent effectivement un risque, mais c'est en les multipliant qu'on en acquerra une meilleure connaissance et la capacité de le limiter. Aux gouvernements donc, de créer les conditions pour que les investisseurs osent innover.

Oser réformer la gouvernance en Afrique

Investir en Afrique pourrait contribuer au développement économique et à l'amélioration des conditions de vie des citoyens. Encore faut-il s'assurer que l'argent soit alloué de manière transparente et les bénéfices distribués équitablement avec les citoyens. Aujourd'hui 2/3 des africains n'ont pas accès à l'énergie alors même que l'Afrique exporte vers les autres pays. La mauvaise gouvernance des états a notamment été pointée du doigt comme frein aux investissements dans les énergies renouvelables. Pourtant les partenariats entre pays africains et pays non-africains pourraient contribuer à débloquer le potentiel énergétique de l'Afrique, avec un impact positif sur l'emploi et l'éducation largement mis en avant au cours de la journée. Il ressort des échanges qu'un enjeu clé pour les pays d'Afrique est d'améliorer leur gouvernance interne, condition nécessaire pour offrir un

environnement propice aux investissements et accélérer les progrès vers les Objectifs de Développement Durable pour 2030 de l'ONU.

Journée dédiée au défi de l'Afrique

CONCLUSION

Les défis environnementaux et l'accès à l'énergie semblent donc être au cœur des débats. Chacun semble vouloir se préparer au mieux pour faire face à ces défis et fait montre d'un certain volontarisme. Les actions concrètes restent limitées mais semblent aller dans le bon sens. Si elle n'est pas réellement engageante, cette volonté affichée reste un signal positif pour le secteur de l'énergie et les jeunes désirant en devenir acteur. Tous ces changements sont en effet autant d'opportunités de rendre l'énergie plus sûre, plus propre et accessible à tous. Comme répété lors du congrès l'énergie devrait être source de coopération et non de conflits. Espérons là aussi que les mots se transformeront en actes.

Ces quatre jours de congrès ont été intenses et instructifs. Pour chacun d'entre nous, futurs économistes de l'énergie, ce fut l'occasion de découvrir la vision de ceux qui font le monde de l'énergie de demain, et d'échanger avec eux. La diversité des sujets abordés, dont le présent rapport ne donne qu'un aperçu, nous a amené à pousser nos réflexions vers d'autres thèmes que ceux que nos thèses respectives nous permettent habituellement d'explorer. Le congrès n'a pas été une simple parenthèse, mais peut-être un trait d'union entre nos études, souvent théoriques, et nos futurs choix professionnels.

LE CONGRÈS EN TWEETS

Les participants au Congrès ont largement partagé leurs impressions en temps réel sur Twitter. Nous y avons contribué à travers le compte "CFE-jeunes" et vous en proposons ici un aperçu :

CFE-jeunes
@CfeJeunes

#UAE @WECongress Introducing renewable #subsidies, as in Germany, would place a huge #burden on our country and people.

CFE-jeunes
@CfeJeunes

Pouyanné, @Total CEO: volatility is inherent to commodity businesses. There is no "normal" #oilprice @WECongress

WorldEnergy Congress
@WECongress

Bob Dudley / @BP_plc : "Renewables are unlikely to contribute more than 15% of the total #energymix by 2035"

CFE-jeunes
@CfeJeunes

Tom Delay @WECongress: governments should de-risk projects prior to tendering them to attract private investment. #riskmanagement

CFE-jeunes @CfeJeunes · Oct 11

#BP recognises a real image problem of oil industry that should be fixed to attract #YOUTH talents to the sector @WECongress #energyindustry

NOS IMPRESSIONS SUR CES QUATRE JOURS DE CONGRÈS

Ces quatre journées de congrès furent l'occasion d'élargir mon regard sur le monde de l'énergie, à travers différents acteurs (des industriels, des membres de gouvernement), venant de diverses régions du monde (pays du Moyen-Orient et d'Afrique notamment).
Si l'objectif est commun - assurer l'accès à une énergie propre pour tous - il ressort du congrès que les défis à relever sont nombreux et varient selon les contextes propres à chaque pays.

L'expérience fut d'autant plus riche qu'elle fut partagée avec trois autres doctorants.
Discuter nos points de vue respectifs, rebondir sur les messages portés, mais aussi échanger sur nos motivations auront largement contribué à enrichir cette expérience et à nourrir mes réflexions personnelles.
Une belle expérience à vivre !

Audrey

Ce congrès à Istanbul m'a permis de plonger dans le monde de la géopolitique de l'énergie. La complémentarité entre cette expérience et les évènements de recherche auxquels j'avais pu participer pendant ma thèse m'apparaît comme un point clé pour mieux comprendre les enjeux du secteur énergétique. Pour moi, cette expérience constitue un moment de riches découvertes, et d'échanges énergisants avec Audrey, Alena et Xavier.

J'ai été très surprise par la volonté affichée et répétée de l'Arabie Saoudite et des Emirats Arabes Unis de participer activement à la transition énergétique en développant des énergies renouvelables. Publicité verte ou prise de conscience ? Le prochain congrès qui se déroulera à Abou Dhabi en 2019 donnera sûrement quelques éléments de réponse…

Marie

Le Congrès Mondial de l'Énergie à Istanbul a été un haut lieu de discussions et décisions de la politique énergétique mondiale. J'ai été impressionnée par le niveau des panels et des discussions : plusieurs présidents, ministres de l'énergie, PDG de grandes entreprises mondiales d'énergie et des banques multilatérales qui ont échangé sur les défis locaux et les meilleures pratiques mondiales pour assurer la sécurité, l'accessibilité et la décarbonisation de l'énergie.

Mes discussions avec les représentants expérimentés du monde énergétique d'aujourd'hui couplées avec mes débats avec les jeunes économistes de l'énergie français et Young Energy Leaders venants des domaines différents ont beaucoup enrichi ma vision et ma compréhension des enjeux énergétiques de demain. Cette expérience me sera certainement utile dans mon parcours professionnel dans le monde des énergies futures. Je tiens à remercier le CFE et particulièrement
Jean Eudes pour cette unique opportunité !

Alena

Ce congrès fut une occasion unique de sortir du cadre académique de ma recherche et d'observer comment les politiques énergétiques sont établies dans les faits. J'ai été marqué en particulier par le fait que si tous s'accordent pour dire que la collaboration entre gouvernements ou entre ceux-ci et les entreprises est nécessaire, la coordination reste un défi considérable.

J'ai aussi remarqué que les petites entreprises et nouveaux entrants étaient assez peu présents, en dépit des changements profonds qu'ils peuvent imprimer aux marchés de demain. J'espère qu'ils seront plus représentés à la prochaine édition!

Le congrès fut aussi l'occasion d'identifier les problèmes qui préoccupent les acteurs de l'énergie, et quelles perspectives s'offrent à eux. Cela m'aidera probablement à orienter ma recherche et mes choix professionnels.
Ce fut une expérience unique et extrêmement enrichissante!

Xavier

Le Conseil Mondial de l'Énergie

Fondé en 1923, le Conseil Mondial de l'Énergie (World Energy Council, WEC) est la principale organisation multi-énergétique mondiale. Organisation à but non-lucratif et non gouvernementale, agréée par l'Organisation des Nations Unies, le Conseil Mondial de l'Énergie est doté d'un statut de bienfaisance au Royaume-Uni et est partenaire stratégique d'autres organisations clés dans le domaine de l'énergie. Il est constitué de comités nationaux, représentant près de 100 pays dans le monde et composé de dirigeants du secteur énergétique. Il est régi démocratiquement par une Assemblée Exécutive, composée de représentants de tous les comités membres. Son siège est à Londres, il comprend parmi son personnel des coordinateurs régionaux qui exercent leurs activités en Asie, en Europe centrale et orientale, en Afrique et en Amérique latine/Caraïbes. Il est financé essentiellement par les cotisations des comités nationaux.

Le Conseil Mondial de l'Énergie couvre une gamme complète de questions liées à l'énergie. Il s'intéresse à toutes les énergies (le charbon, le pétrole, le gaz naturel, l'énergie nucléaire, l'hydraulique et les nouvelles énergies renouvelables). Il réalise des projections à moyen terme et long terme et travaille sur un grand nombre de thèmes liés à l'énergie (efficacité énergétique, environnement et énergie, financement des systèmes énergétiques, prix de l'énergie et subventions, pauvreté et énergie, éthique, normes, nouvelles technologies,...). Le Conseil Mondial de l'Énergie réalise des analyses, des recherches, des études de cas et des orientations stratégiques publiées sous forme de rapport et utilisées par les principaux décideurs. Des cycles de travail de trois ans aboutissent au Congrès Mondial de l'Énergie, événement majeur de l'industrie énergétique attirant plus de 5 000 délégués, incluant un programme technique, des réunions, des séances de travail en réseau et une importante exposition sur l'énergie.

Plus d'informations sur **www.worldenergy.org** et **@WECouncil (twitter)**

Comités membres du Conseil Mondial de l'Énergie

Afrique du Sud
Albanie
Algérie
Allemagne
Arabie Saoudite
Argentine
Autriche
Bahreïn
Belgique
Bolivie
Botswana
Brésil
Bulgarie
Cameroun
Canada
Chili
Chine
Chypre
Colombie
Congo
Corée
Côte d'Ivoire
Croatie
Danemark
Egypte
Espagne
Émirats Arabes Unis
Équateur
Estonie
États-Unis
Éthiopie
Finlande
France
Gabon
Ghana
Grèce
Hong Kong, Chine
Hongrie
Inde
Indonésie
Irak
Iran
Irlande
Islande
Israël
Italie
Japon
Jordanie
Kazakhstan
Kenya
Koweït
Liban
Lettonie
Libye
Lituanie
Luxembourg
Macédoine
Maroc
Mexique
Monaco
Namibie
Népal
Niger
Nigéria
Nouvelle-Zélande
Pakistan
Paraguay
Pays-Bas
Pérou
Philippines
Pologne
Portugal
Qatar
République tchèque
Roumanie
Royaume-Uni
Russie
Sénégal
Serbie
Slovaquie
Slovénie
Sri Lanka
Suède
Suisse
Swaziland
Syrie
Taiwan, Chine
Tanzanie
Tchad
Thaïlande
Trinidad-et-Tobago
Tunisie
Turquie
Ukraine
Uruguay
Zimbabwe

Le Conseil Français de l'Énergie

Fondé en 1923, le Conseil Français de l'Énergie (CFE) est le comité national français du Conseil Mondial de l'Énergie. Ce dernier rassemble plus de 3 000 organisations et représente une centaine de pays dont les deux tiers de pays en développement. Il représente ses membres dans toutes les activités internationales du Conseil Mondial de l'Énergie.

Le Conseil Français de l'Énergie est une association qui a pour objectif de promouvoir la fourniture et l'utilisation durables de l'énergie pour le plus grand bien de tous. Le Conseil Français de l'Énergie regroupe des acteurs français (entreprises, administrations, organisations professionnelles ou universités) impliqués dans des réflexions qui privilégient les dimensions d'accessibilité, de disponibilité et d'acceptabilité de l'énergie dans une perspective mondiale ; toutes les ressources et les technologies de l'énergie sont représentées.
Le Conseil Français de l'Énergie soutient les recherches en économie de l'énergie et participe aux débats énergétiques, notamment par l'intermédiaire de publications et de conférences.

Le Conseil Français de l'Énergie assure la diffusion des résultats des recherches qu'il a financées. De plus, le français étant l'une des deux langues officielles du Conseil Mondial de l'Énergie, le Conseil Français de l'Énergie contribue à la promotion de la francophonie en traduisant en français et en diffusant les travaux les plus importants du Conseil Mondial de l'Énergie.

Plus d'informations sur **www.wec-france.org** et **@CFE_WEC_France (twitter)**

Membres du Conseil Français de l'Énergie (au 1er mai 2016)

▸ Membres partenaires

▸ Membres scientifiques et professionnels

ANAH - AFG - ASTEE - ATEE - CGEMP - CIRED - CPDP - CNISF - Enerdata SA - FEDENE - FNCCR - FAIF IESF - OIE - UNIDEN

▸ Membres associés

Pascal Faure, Directeur Général de la Direction générale des entreprises (DGE)
Laurent Michel, Directeur Général de l'Énergie et du Climat (DGEC)
Virginie Schwarz, Directrice de l'énergie à la Direction Générale de l'Énergie et du Climat (DGEC)
Pascal Dupuis, Chef du Service Climat et Efficacité énergétique (DGEC)
Patricia Blanc, Directrice Générale de la Direction générale de la prévention des risques (DGPR)

François Ailleret – Olivier Appert – Jean Bergougnoux – Marcel Boiteux – Jean-Marie Dauger – Claude Destival – Pierre Gadonneix – Jacques Maire – Bruno Weymuller

PUBLICATIONS

- Synthèse « Les mesures non tarifaires : prochaines étapes vers une économie bas carbone » (2016)
- Synthèse « Les ressources énergétiques mondiales » (2016)
- Synthèse « Le chemin vers la résilience - gestion des cyber-risques » (2016)
- Synthèse « Indice de développement durable » (2016)
- Synthèse « Scénarios énergétiques mondiaux 2016 : la grande transition » (2016)
- « 5th European Energy Forum: R&D and innovation, drivers of the energy transition » (2016)
- « Les enjeux énergétiques mondiaux vus par les acteurs français » (2016)
- « 4th European Energy Forum – On the Way to COP21 » (2015)
- « Trilemme Énergétique Mondial - Financement : mythes et réalités » (2014)
- « 3rd European Energy Forum – What Policy Measures for Energy Transition in Europe? » (2014)
- « 22e Congrès Mondial de l'Énergie – Incertitudes et résiliences » (2013)
- « Scénarios Mondiaux de l'Énergie à l'horizon 2050 – Mises en musique du futur de l'énergie » (2013)
- « Les politiques d'efficacité énergétique dans le monde – ce qui marche et ce qui ne marche pas » (2013)
- « Trilemme Énergétique Mondial – Investir dans l'énergie durable » (2013)
- « Trilemme Énergétique Mondial – Le programme du changement » (2013)
- « Les enjeux énergétiques mondiaux vus par les acteurs français » (2013)
- « 60e Congrès AFSE Économie des Énergies : prix et incertitudes » (2011)
- « Politiques pour demain » (2011)
- « Le gaz de schiste : résumé et commentaires » (2010)
- « Montréal 2010 : parole aux jeunes » (2010)
- « Objectif : développement durable » (2010)
- « Énergie et innovation urbaine » (2010)
- « Efficacité énergétique : la recette pour réussir » (2010)
- « Conséquences de la crise sur le secteur de l'énergie » (2009)
- « Cahiers de l'Énergie n°1 » (2009)
- « Choisir notre futur : scénarios de politiques énergétiques en 2050 » (2007)
- « Une seule planète pour tous » (2003)

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