Renewable Energy Committee

2017 EMD Renewable Energy Committee Annual Report

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Version 1 – Executive Summary

Vice-Chairs:

- TBA, Vice-Chair (Industry)
- TBA, Vice-Chair (University)
- TBA, Vice-Chair (Government)

Advisory Group

- TBA

Special Consultants to the Renewable Energy Committee:

- **Zhiruo (Amber) Zhou**, M.S. (Rice University), Intern at I2M Associates, LLC.

Committee Activities

This Executive Summary of the 2017 Annual Report of the Renewable Energy Committee will be followed by the full report when completed and reviewed by the new Committee Vice-Chairs and members of the Advisory Group. The full report will be available on the EMD Renewable Energy Committee website.

Executive Summary

- The objectives of this report are to inform members of the EMD, AAPG and the general public on the development of renewable energy and how the technology developments impacts the oil and gas industry. This report also aims to provide updates to research in the construction, installation, and application of renewables to supply electricity in the U.S. and elsewhere (via wind, solar, hydroelectric (dams and pumped storage), tidal, biofuels, ethanol, and waste-to-energy systems).

- Petroleum use is dominant in the transportation sector, but renewable energy is beginning to occupy the market shares once held by coal and natural gas, especially in electric power generation sector for rural regions.

- Renewable integration into the grid is quickly becoming a setback as renewable sources of power grow and grid operators are seeking new solutions to integration. But there is now a significant amount of wind and solar power being integrated into the electricity market.

- A significant reduction in nuclear capacity may offer an opportunity for renewables to gain the market. Recently, the Indian Point nuclear power plant that now provides about a quarter of the electricity in New York City and nearby counties announced its closure by 2021.Besides, nearly 10.6 GW of long-term nuclear plants retirements move away from markets and create space for renewables to compete, assuming the cost structure is not prohibitive.

- Recently, the U.S. was the second-highest ranked country (only after China) in total amount of new investments in renewable energy and energy-smart technologies. Investments in these two sectors reached $59 billion in 2016 and $507 billion over the past decades.

U.S. Electricity Production and Costs

- In 2016, the U.S. consumed 10,160 Trillion Btu of renewable energy, totaling 10 % of all energy consumption. 55% percent of the renewable consumption was in electric power sector, compared to 23% in industrial sector and 14% in transportation sector.

- U.S. production of renewable energy in the third quarter of 2016 slightly slowed down to 2,416 trillion Btu, an 8% decrease compared with the peak quarter in the same year. But in general, the quarterly production of renewables was relatively steady in 2016.

- In 2015, renewables took up 9.9% of all energy consumptions and accounted for 13.4% of the national electricity production in the U.S..

- Global levelized cost of electricity (LCOE) of solar photovoltaic generation fell from $315 per MWh in 2009 to $100 per MWh in 2016. The cost of onshore wind decreased to $68 per MWh in 2015. Offshore wind notably decreased to around $126 per MWh in 2016.

- The cost of constructing a utility-scale photovoltaic project decreased 57% at a global level, and the cost of wind turbines dropped from $1.34 million per MW to $1.12 million per MW within four years.

- In the United States, 20 states and the District of Columbia have established renewable portfolio standards (RPS) that require utilities in each state to supply a certain portion of electricity from renewable resources.

Employment in Renewable Energy

- States with substantial solar, wind, and fossil fuel resources presented great employments both in conventional fuels and renewable energies, even taking falling fossil fuel prices into account. But states like West Virginia that are highly dependent on coal consumption suffered from declines in employment rates since 2015.

- A total of 112,642 workers are employed in bioenergy electric generation and biofuel sub-technologies. More women are employed in bioenergy/biomass electric generation than in other individual biofuel technologies. The generation sector also hires more Hispanic or Latino and Asian employees, showing more diversity compared with other types of fuels.

Tax Advantages in Renewable Energy

- Despite the uncertainty in U.S. tax policy or attitude towards climate change, large corporations may keep flexing their buying power, especially in corporate renewable procurement. Therefore, the renewable energy sector will likely not slow its rate of development.

- The federal renewable electricity production tax credit (PTC) is a per-kilowatt-hour tax credit for electricity generated by qualified energy and sold by the taxpayer. It applies to wind, closed-loop biomass, and solar systems.

- The Investment Tax Credit (ITC) allows corporations tax credit based on the amount invested rather than electricity produced, which is quite different from the PTC. ITC is a 30% tax credit for the cost of solar system installations both in residential and commercial properties through 2019. It will drop to 26% in 2020 and continue falling to 22% a year later. In 2022, commercial credits are planned to decrease to 10% while the residential credits will expire.

- MACRS stands for the Modified Accelerated Cost Recovery System that currently applies for tax deduction calculations for depreciable assets. All ITC-related technologies as well as large wind projects are eligible for this tax policy.

Hydroelectric Activities

- 2015 was a milestone year for global investment in renewable energy. Excluding large hydro-electric projects, the amount of money invested in renewables rose 5% to $285.9 billion, exceeding the former record of $278.5 billion achieved in 2011. Note that 2015 also witnessed a rapid decline in oil, coal, and gas prices, which protected the competitive position of fossil fuel generation due to the low buying cost.

- In 2015, renewables excluding large hydroelectric projects made up the majority, 55.6%, of the gigawatt capacity of all installations the first time.

- In December 2015, the House of Representatives passed the North American Energy Security and Infrastructure Act, and the Senate passed the Energy Policy Modernization Act of 2015 to facilitate an easier and faster licensing process for hydropower. This is an improvement because currently the licensing process can take up to 10 years, thereby causing delays and setbacks in new and existing hydropower developments.

- Approximately 28 GW of new hydropower capacity was added to the market in 2015, which increased total global capacity to about 1,064 GW. However, continuing droughts in several areas, including the Americas and Southeast Asia had an adverse impact on the hydropower developments. Climate risk and competition from other renewables in the market shares are also driving further improvements of hydropower.

- Existing non-powered dams have become the main target of new hydropower developments. Based on research from the Department of Energy, the largest 100 non-powered dams potentially have as much as 8GW electricity capacity.

Wind and Solar Activities

- Wind and solar power account for nearly two-thirds of the growth in renewable generation with solar being the fastest-growing renewable. Wind has the largest absolute increase in generation and is projected to replace hydropower as the largest source of renewable energy by 2040 replacing hydropower.

Wind Activities

- Wind power is a mainstream power source that supplies 6% of U.S. electricity. In total, the U.S. installed 8,203 MW of wind capacity in 2016, making wind energy the top one source of national renewable energy capacity.

- Oklahoma is a pioneer among other states with 270 MW of wind capacity installed, followed by lowa (154 MW), Utah (62 MW), and New Mexico (32 MW). So far, Oklahoma has invested more than $6 billion in the construction of wind farm and created more than $340 million in labor income to the state.

- Currently, 102,000 workers are employed at wind firms across the nation – a 32% increase since 2015. 37.2% percent of the employment is in construction, compared to 29.0% in manufacturing and14.0% in trade. In fact, job opportunities in wind power have grown more than 25% a year, and there is estimated to be a substantial and growing need in wind turbine technicians.

- GE Renewable, Siemens, and Vestas occupied over 99% of the wind turbines market share in the first quarter of 2016. Alliant Energy also announced a 500 MW Whispering Willow expansion plan in lowa in addition to reported total 1,216 MW in new advanced development

in wind power industry.

- The new administration aims to enable private investments in American infrastructure, which may stimulate the construction of electric transmission pipelines. Expanded transmission would cross more states with abundant wind resources like Wyoming, Montana, and New Mexico and open more markets for wind power supplies.

- The U.S. issued its historic first offshore 30 MW wind project off the coast of Rhode Island in 2016.

- New York showed support for offshore wind power and held an auction on December 16, 2016 for the rights to a wind farm located in federal waters 12 miles off Long Island. This auction also helped New York state to achieve its goal of generating 50% of its energy from renewables by 2030 to support America's largest population centers.

- In the U.S., offshore wind resources are located in deep waters where conventional foundations such as large steel piles or lattice structures fixed to the seabed are impractical. There are potential needs for developing creative floating offshore wind platforms.

- China owns 31% of the world's installed wind capacity, but China meets less than 3% of its supply need through wind energy and still face the challenges of a lack of transmission infrastructure and the curtailment of wind generation.

- In 2015, the European Union also reached a new record in wind energy, where over 60 Gigawatts of new wind turbine were installed. Wind power takes up 44% of new power capacity installations, which is a greater percentage than any other technology.

Solar Activities

- The U.S. almost doubled the solar PV capacity in 2016, providing 14,762 MWdc of solar PV to over 370,000 individuals. In 2016, a record 22 states each added more than 100 MW of solar PV, and California remained the largest state market for solar energy.

- Policy partially contributed to this boom of solar power in 2016. In 2014 and 2015, developers and utilities anticipated a step-down in the federal investment tax credit in the year of 2016. To capture full tax credits, they submitted a large number of construction plans that have contractual obligations to begin operation at the end of 2016. Despite the official extension of ITC in late 2015, most construction plans remained unchanged.

- Solar cells based on dye-sensitized solar cells, organic compounds, perovskite materials, and inorganic quantum dots have been hugely popular and are garnering R&D efforts. These are gathering interest because they are promising to be less expensive than typical silicon cells and well suited to many more applications.

- The surface of the Moon independently receives 13,000 TWs of solar power. Converting the lunar solar power on the Moon into electric power to beams of around 2.5 GHz microwaves to Earth, feasible way for solar energy applications.

Tidal Energy Activities

- Ocean energy capacity, mostly tidal power, remained at about 530 MW in 2015. The dominant ocean energy deployments in 2015 were demonstration projects with most activity focused on tidal energy technology, followed by wave energy conversion devices.

Biofuel Activities

- The federal renewable fuel standard (RFS) is the key driver of the biofuel industry. It mandates transportation fuel sold in the U.S. to contain a minimum volume of renewable fuels. The main application of ethanol and biodiesel is blending them with gasolines to reduce transportation carbon emissions.

- In 2016, the U.S. installed 77MW of biomass and 54MW of biogas.

- With 60.3 million gallons published under RFS2, the U.S. estimates 113 million gallons of annual cellulosic ethanol production capacity. The amount of production was not as large as expected in 2010 due to insufficient capacity. RFS also has also reduced the renewable volume obligations for cellulosic ethanol in transportation fuels since 2010.

- The U.S. and Brazil achieved new records in ethanol production, which contributed to a 4% increase of global ethanol production in 2015. Constrained production in some Asian markets slightly reduced the global production of biodiesel. But 2015 witnessed great progress in the commercialization and deployment of biofuels, with expansions in other applicable biofuels routes such as thermal technology.

Waste-to-Energy Projects

- In February 2017, the Asian Development Bank (ADB) signed agreements with 10 commercial banks to assist Dynagreen Environment Protection Group, the Beijing State-owned assets management company, in clean municipal waste-to-energy (WTE) projects.

- There was no new installation of waste-to-energy plants in the U.S. in 2016. The most recent construction was the 85MW Palm Beach Renewable Energy Facility Unit 2 in 2015.

- Waste-to-energy plants in the U.K. boost more supports from the government. England constructed five new facilities totaling 180 MW in electrical generating capacity and 70 MW of export steam capacity.

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