INTRODUCTION
The theme of this issue is renewable energy in the Middle East and North Africa.

The Middle East and North Africa (MENA) region holds more than half of the world’s proven crude oil reserves and more than 41 per cent of its proven natural gas reserves. For the past fifty years, some of these countries have grown into global energy suppliers and have experienced rapid industrialization and rise in living standards – especially the countries of the Gulf Cooperation Council. The region experienced its fastest economic growth in the seventies, and today its annual energy demand is growing at the rate of two per cent, second only to the growth in South and East Asia.

This rapid growth has been fuelled by the availability of fossil fuels – oil and natural gas at extremely low prices. However, as the region has grown economically, its domestic consumption of energy has also grown steadily. As a result, MENA is now diverting an increasing share of its oil and gas production from export markets to domestic consumption, resulting in a sizeable opportunity cost. With OECD statistics suggesting that the region’s aggregate electricity demand could grow by six per cent annually between 2010 and 2030, this opportunity cost could potentially grow into a significant sum.

Furthermore, it is important to understand that MENA is a very diverse region – consisting of major oil and gas producers (known as net energy exporting countries or NECs such as Saudi Arabia), and countries that rely on imports for the majority of their energy needs (known as net energy importing countries or NICs such as Jordan). Thus, while the NECs forego an opportunity cost only when they use their oil and gas for domestic needs, the NICs incur steep import bills as energy demand grows and energy prices increase. For example, in 2009, Jordan’s import fuel bill was equivalent to almost 13 per cent of its GDP.

Thus renewable energy sources are becoming an increasingly attractive alternative for the region. Besides wanting to reduce the dependence on fossil fuels, other factors that are creating a pull towards renewable energy include their lower water requirements, their potential to enhance energy security, and their potential to create new jobs. Diversification of...
energy supply is also desirable, as is demonstration of the region’s commitment to be a part of the global climate change solution.

The MENA region countries have tremendous solar and wind resource potential. According to World Bank estimates mentioned in an International Finance Corporation report, the region receives 22 to 26 per cent of all solar energy reaching the earth. This region’s solar power potential even exceeds global electricity demand. Wind, hydro, geothermal and biomass also have significant potential, but are nowhere near the huge amount of solar energy available. Yet the region has lagged in exploiting this potential. In 2008, only one per cent of the region’s primary energy consumption was supplied in the form of renewable energy. In 2012, more than 90 per cent of MENA’s installed renewable energy capacity was comprised of hydro, with wind contributing another 5.5 per cent.

The first article in this issue is by Mr Assaad Razzouk, CEO and co-founder of Sindicatum Sustainable Resources, a clean energy company based in Singapore. In his “Clean Energy in MENA: Enormous Potential, Little or No Action”, Mr. Razzouk summarises the enormous potential for renewable energy in the region and argues that there has been little policy thrust towards this sector. He notes that although the MENA region lauded the historic climate change agreement concluded in Paris in December 2015, the prospects for renewable energy do not look favourable unless a number of key challenges are overcome.

The second article by Dr Mohamed Mostafa El-Khayat, Vice-Chairman for Research, Studies and Technical Affairs, and Ms Enjy Hassan HassabAllah, Studies Engineer, Wind Energy Department at the New and Renewable Energy Authority (NREA), Egypt presents the landscape for renewable energy development in Egypt. While Egypt has been an early mover and currently supplies six to eight per cent of its annual electricity demand through hydropower, its potential for new hydropower projects is almost exhausted. Thus, it is now planning PV and wind installations of 4,300 megawatts. Feed-in tariffs have been promised but may not be sufficient.

The third article by Dr Hong Wai Mun, Research Associate, MERIGG, Universidad Autónoma de Madrid, focusses on renewable energy development in Algeria and Morocco. The two countries have large solar and wind resources and both have set ambitious targets for renewable energy – 20 per cent of total electricity by 2030 for Algeria, and 42 per cent by 2020 for Morocco. The two countries already have a sizeable percentage of electricity generated from solar and wind, but the huge subsidies for fossil fuel sources must be addressed before further development of renewable energy can occur.

The final piece by Dr Nadejda Komendantova, Research Scholar at the International Institute for Applied Systems Analysis (IIASA) examines risk reduction for foreign direct investment in solar projects in North Africa. She argues that regulatory risks and political risks add significantly to the cost of financing solar projects in the region. As a result, countries that receive the most solar investment are those with well-developed financial sectors rather than those with the best resource potential. Thus, a number of financial de-risking and policy de-risking initiatives are required such as public-private partnerships, risk insurance guarantees, removal of regulatory barriers, and streamlining of permission procedures.

We hope you find these articles of interest and we welcome your views and comments.

Gautam Jindal (Research Associate)
(On behalf of the ESI Bulletin Team)

2. World Bank, World Development Indicators 2013 database.
Clean Energy in MENA: Enormous Potential, Little or No Action

Mr Assaad Razzouk, CEO and co-founder of Sindicatum Sustainable Resources, Singapore

At a gathering in May 2015 convened by the French Government ahead of the Paris climate talks, or COP21, Saudi Arabia’s oil minister was asked about his country’s strategy after the end of the oil era. His answer: We will keep exporting energy, except it will be solar power which we will sell to the world. The crowd, composed mainly of climate activists and other supporters of a transition to a world fuelled 100 per cent by clean energy, loved it.

In November and December 2015 however, at COP21, Saudi Arabia was quite transparent in its failed efforts to sabotage a climate agreement. The two contrasting Saudi positions superficially make perfect sense. In the short term, Saudi wants to block meaningful action on climate change because its oil revenues underpin its rulers’ mandate to rule, via generous welfare and energy subsidies. In the medium and long-term however, thoughtful Saudis understand that the end of the age of oil is near – and the beginning of the end is with us now.

In the interim, Saudi acts as if it were blissfully unaware of the security threats it faces because of climate change. According to a study published in the journal, Nature Climate Change, the Gulf Region (Saudi, Kuwait, Qatar, the United Arab Emirates, Bahrain and Yemen) will suffer greatly from global warming, with the potential for the region to sink into heatwaves that are beyond the limit of human survival.

Meanwhile, 4,000 miles away at the other end of the Middle East and North Africa region, something special is going on in Ouarzazate, Morocco’s famed “door of the desert” Berber city. No, it’s not the shooting of a sequel for “Lawrence of Arabia”, one of many movies shot there. More in tune with the times, Morocco is building mega-solar plants that will play a key role in providing power to one million people, as well as in ensuring Morocco generates approximately 50 per cent of its electricity from renewable sources by 2020.

Morocco’s motivation and enthusiasm are well-founded: Until recently, the country imported approximately 90 per cent of its energy in the form of fossil fuels, a $10 billion burden on its public finances. Furthermore, it is richly endowed with free sun and wind – and eventually could export energy to Europe. It is the same story in Jordan, which currently spends 14 per cent of its GDP (approximately $3.6 billion) on energy imports, while being blessed with free sun almost year-round.

Clean Energy Century

In the Middle East and North Africa region, it is quite clear that clean energy, especially solar power, could have the same impact in the twenty-first century that oil production had in the twentieth.

The potential for solar power from the desert has been very well understood, at least since German scientist Gerhard Knies calculated in 1986 that desert sun can easily power the world, provided the energy can be transported closer to where it is needed.

But the MENA countries with the greatest deserts of all, Saudi Arabia, Algeria, Libya and others, ignored this potential. Some 30 years later, at COP21, 195 countries (Saudi Arabia and Algeria among them) set themselves on a low-carbon path via economy-wide plans sure to be developed and strengthened every year.

We can therefore expect solar power and other forms of clean energy to continue their onward march in 2016. These
already partially monopolise additions to electricity supply worldwide. Orders for new clean energy power plants are up sharply in the United States, China, India, as well as in the developing economies of Africa and Latin America. India, for example, with current electricity grid capacity of less than 300 gigawatts (GW), has plans to build 100 GW of solar power by 2022 (from 5 GW currently), double the current solar capacity of China.

Meanwhile, cheaper battery technology will continue to drive clean energy costs down, while changing the way people think about energy: We will produce more electricity from solar power, but also store and manage it ourselves. This foretells nothing short of a revolution in the way our modern society fuels itself, upending previous assumptions about the need for large fossil fuel plants connected by an expensive, inefficient electricity grid.

So where do the MENA countries stand? In short, with the exception of Morocco and perhaps Egypt and Jordan, nowhere. And regrettably, they are likely to miss out on the clean energy century.

**MENA Overview**

The current clean energy picture in MENA is appalling. Working against their best interests, oil producing countries are perpetuating fossil fuel subsidies without developing their clean energy sector while non-oil producing countries are not pushing hard enough, with the notable exception of Morocco. Table 1 below shows the lack of ambition in the MENA region.

<table>
<thead>
<tr>
<th>MENA Clean Energy Ambitions</th>
<th>% From Renewables</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morocco</td>
<td>42%</td>
<td>By 2020</td>
</tr>
<tr>
<td>Tunisia</td>
<td>30%</td>
<td>By 2020</td>
</tr>
<tr>
<td>Algeria</td>
<td>25%</td>
<td>By 2030</td>
</tr>
<tr>
<td>UAE</td>
<td>24%</td>
<td>By 2021</td>
</tr>
<tr>
<td>Egypt</td>
<td>20%</td>
<td>By 2020</td>
</tr>
<tr>
<td>Jordan</td>
<td>10%</td>
<td>By 2020</td>
</tr>
<tr>
<td>Other</td>
<td>Not Meaningful</td>
<td></td>
</tr>
</tbody>
</table>

Conspicuously absent from Table 1 is Saudi Arabia, together with Qatar and Kuwait. Saudi Arabia, the region’s largest economy, had 17 MW of installed renewables capacity in 2014, a ridiculously insignificant number. To put that in context, world solar capacity topped 200 gigawatts in 2015 and is expected to reach 321 gigawatts by the end of 2016. Saudi Electricity Company, responsible for 75 per cent of the generation capacity in the Kingdom and Saudi Aramco, the world’s largest oil company, are key stakeholders in the status quo. In part because of their power, Saudi has failed to develop a renewable energy framework or to act in any meaningful way on what the country’s own oil minister has indicated is the clean energy future ahead.

Similarly, the UAE had a puny 241 MW of installed renewable energy capacity in 2015. Its ambition, however, of generating 24 per cent of its energy needs from renewables by 2021 is more respectable. Furthermore, in June 2015, the UAE at least formed the new Emirates Green Development Council to ensure effective collaboration between federal and local authorities and stakeholders, a step in the right direction. Dubai’s plans to install solar panels on every roof of every building by 2030 is also very encouraging – if it happens.

One has to travel from the Gulf, North to Jordan and East to Egypt and Morocco, to find more credible plans for clean energy infrastructure. Egypt’s 2015 renewable energy capacity is a respectable 770 MW and its ambition to derive 20 per cent of its electricity needs from renewables by 2020 is commendable, given its current difficulties in attracting foreign direct investment at an attractive cost of capital.

Egypt’s regulatory framework for clean energy is also relatively comprehensive and coherent. In 2014, the New and Renewable Energy Agency was allowed to develop and operate renewable energy projects and to delegate such projects to the private sector. A five-year fuel subsidies reduction plan introduced in July 2014 will phase out almost all hydrocarbon fuel subsidies in Egypt by 2019.

Renewable energy incentives in Egypt include the allocation of government-owned land free of charge or at discounted prices. Tax and tariff incentives are in place and investors proposing installations larger than 20MW can benefit from sovereign guarantees: If the Egyptian Electricity Holding Company is unable to fulfil payments for delivered electricity, the Egyptian Ministry of Finance will cover the payments. It is the same story in Jordan which relies on fossil fuel imports to meet approximately 95 per cent of its energy demand, a massive drain on its modest resources. Jordan is on track to connect renewable energy projects with a

Sources: Several, including SeeNews, Energypedia, Cleantechnica, Lexology and the International Energy Agency.
Renewable Energy announced the Feed-in Tariff “FiT” Phase On 20 September 2014, H. E. Minister of Electricity and 2020 to come from renewable energy.

In 2013, Egypt received a total of around USD 24.42 million help address challenges related to peak load, and the build a 2,000 MW pumped-storage hydroelectric plant to country’s large-scale hydropower capacity has already been cent of Egypt’s annual electricity needs, and most of the

Key challenges that need to be overcome include introducing financial-grade regulatory regimes and enhancing grid infrastructure. Flip-flopping on policies, announcements without follow-up, inconsistencies and the lack of stable, long-term regulatory frameworks will maintain the current low levels of investment into clean energy. In addition, experience elsewhere (from Japan to Europe to California) shows that it is only by interconnecting systems across borders that the transition to renewables can be achieved economically, and fast. We need a seamless, densely-interconnected, transnational regional grid but this is not a prospect that can be credibly contemplated anytime soon in the MENA region.

The author can be contacted via Twitter: @AssaadRazzouk.

Renewable Energy in Egypt
Dr Mohamed Mostafa El-Khayat, Vice-Chairman for Research Studies, and Technical Affairs, New and Renewable Energy Authority (NREA), Egypt
Ms Enjy Hassan HassabAllah, Studies Engineer, Wind Energy Department, New and Renewable Energy Authority (NREA), Egypt

Introduction
Egypt faces a major challenge in providing a sufficient amount of electricity from its primary energy resources, especially oil and natural gas that contribute to 94 per cent of the total energy resources needed for generating electricity in the country. In recent years, the demand for electricity has grown significantly due to Egypt’s socio-economic development. Peak electricity demand increased by more than four times, from around 7 GW in 1980 to about 26 GW in 2014 and the total installed capacity reached 32 GW, as of the end of 2015.

Hydropower currently supplies between six to eight per cent of Egypt’s annual electricity needs, and most of the country’s large-scale hydropower capacity has already been developed. However, in 2014, Egypt announced plans to build a 2,000 MW pumped-storage hydroelectric plant to help address challenges related to peak load, and the volatile nature of solar/wind-based electricity.

In 2013, Egypt received a total of around USD 24.42 million in subsidies. These had a negative impact on the national GDP; for instance, subsidies in fiscal year 2010/2011 totalled around 25 per cent of public expenditure, while public salaries were 22 per cent. In the same context, the share of the energy sectors is around 11.3 per cent of the national GDP.

Egypt’s total primary energy demand has grown at an average annual rate of 4.5 per cent over the last two decades. This rather high rate is linked to strong economic growth and is particularly reflected in the rapid increase in demand for electricity and transport services which in return increases the role of renewable energy in the energy mix. Egypt has tremendous potential for renewable energy: in 2008, the Supreme Council of Energy announced a national target of 20 per cent of the total electricity generated in 2020 to come from renewable energy.

On 20 September 2014, H. E. Minister of Electricity and Renewable Energy announced the Feed-in Tariff “FiT” Phase example. Saudi Arabia burned nearly 900,000 barrels of oil per month in the summer of 2014 to meet domestic electricity demand which could easily have been met with solar power. This oil should have been exported instead of given away domestically virtually for free; and,

- abundant free sun and wind across the region.

Figure 1: Sources of Electricity, 2014/2015.

Source: Egypt Ministry of Electricity and Renewable Energy.
There are another two projects in the implementation phase in the Gulf of El-Zayt, with a total capacity 340 MW. Another 800 MW of wind energy capacity is in the preparation phase: 600 MW in the Gulf of Suez and 200 MW in Nile West.

Through the FiT mechanism, the private sector is expected to install around 2,000 MW during this year and next. Also, the private sector is cooperating, through competitive bidding tenders, to install and operate wind energy projects. In April 2015, the lowest price globally for electricity produced from a wind energy project, 250 MW, was offered in Egypt, at USD 0.4 cents per kWh for 20 years. Following that, in September 2015, Egypt announced another 250 MW of wind energy projects.

**Solar Energy Projects in Egypt**

Egypt is a sunbelt country that enjoys high solar radiation. It has one of the largest potentials for solar energy applications with approximately 325 days of sun per year and an estimated 2,400 hours annually for potential solar operations. The Egyptian Solar Radiation Atlas, issued in 1991, stated that the average direct normal solar radiation ranges between 2,000–3,200 kWh/m²/year from North to South, with very few cloudy days, and a sunshine duration ranging between 9 to 11 hours per day.\(^1\)

In July 2011, the Kuraymat 140 MW Integrated Solar Combined Cycle Power Plant, of which solar produces 20 MW (CSP technology), was one of three similar projects being implemented in Africa (Morocco, Algeria and Egypt), and mainly depends on integrating a solar field with combined cycle.

The total area of the integrated solar field is about 644 thousand square metres and there are about 1,920 solar collectors containing 53,760 mirrors. The total investment cost of the project was about USD 340 million including a USD 50 million grant from the Global Environmental Facility (GEF). In September 2015, Egypt announced a 50 MW concentrated solar project (CSP) through a competitive bidding approach. Planned for installation in the west Nile area, the developer will install and maintain the project for 25 years.

As for photovoltaic applications, Egypt has around 70 MW. The largest capacity exists at Siwa (10 MW) which is connected to the local grid. There are also more than 7,000 PV rooftop systems already erected in remote areas. Furthermore, Egypt is planning to erect additional capacity, 300 MW, from rooftop systems through the FiT scheme. Another 240 MW are under development through both governmental cooperation and a competitive bidding scheme.

**Conclusion**

Egypt is accelerating the pace of adopting renewable energy, along with the legal frameworks, policies, incentives, and implementation. In terms of legislation, the new Egyptian Constitution of 2014 includes a dedicated clear statement calling for the maximisation of the role of natural resources. In addition, both Law 203 (2014) and the FIT decree target 4,300 MW from both wind and PV technologies.

Despite these legislations, challenges such as applying innovative financial mechanisms to achieve the current target still exist. Efforts are still needed to achieve 20 per cent of electricity from renewable energy resources by the year 2020, and to consolidate the current incentives and promotion schemes. That is to say, for FIT, the share of rooftop applications is relatively small and still needs further consideration. This will assist in reducing electricity demand in the residential sector and also in increasing the share of renewable energy in the electricity portfolio.
Appendix 1: Renewable Energy Feed-in Tariff in Egypt

In September 2014, Feed-in Tariffs (FiTs) were announced for both wind and solar photovoltaic projects. Projects range from small- to large-scale. This step will help Egypt deal with the increasing demand for energy. The FiT mechanism aims to achieve 2,000 MW from wind energy and also from PV. The maximum capacity per project is 50 MW. In addition, another 300 MW from rooftop PV systems is planned. Power purchase agreements will be valid for 20 and 25 years for both wind and PV, respectively. See Appendix 2 for further details.

Shortlisted developers for both wind and PV technologies have been announced. The announced tariffs have attracted national and international developers to invest in Egypt. As a result, the targeted 4,000 MW are almost totally booked. Based on the lessons learned from this round, another round is expected.

For rooftop on-grid systems, the NREA applies a certification programme for PV installers. More than 100 PV installers are already certified. At the same time, through governmental cooperation between Egypt and United Arab Emirates,

Appendix 2: Planned Wind and PV Projects in Egypt

Wind Energy Projects

<table>
<thead>
<tr>
<th>Number of full load Hours in operation</th>
<th>Phase 1</th>
<th>Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USS/kWh</td>
<td>EGP/kWh</td>
</tr>
<tr>
<td>2500</td>
<td>0.1148</td>
<td>0.8208</td>
</tr>
<tr>
<td>2600</td>
<td>0.1148</td>
<td>0.8208</td>
</tr>
<tr>
<td>2700</td>
<td>0.1148</td>
<td>0.8208</td>
</tr>
<tr>
<td>2800</td>
<td>0.1148</td>
<td>0.8208</td>
</tr>
<tr>
<td>2900</td>
<td>0.1148</td>
<td>0.8208</td>
</tr>
<tr>
<td>3000</td>
<td>0.1148</td>
<td>0.8208</td>
</tr>
<tr>
<td>3100</td>
<td>0.0957</td>
<td>0.684</td>
</tr>
<tr>
<td>3200</td>
<td>0.0957</td>
<td>0.684</td>
</tr>
<tr>
<td>3300</td>
<td>0.0957</td>
<td>0.684</td>
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<tr>
<td>3400</td>
<td>0.0957</td>
<td>0.684</td>
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<tr>
<td>3500</td>
<td>0.0957</td>
<td>0.684</td>
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<tr>
<td>3600</td>
<td>0.0957</td>
<td>0.684</td>
</tr>
<tr>
<td>3700</td>
<td>0.0957</td>
<td>0.684</td>
</tr>
<tr>
<td>3800</td>
<td>0.0957</td>
<td>0.684</td>
</tr>
<tr>
<td>4000</td>
<td>0.0957</td>
<td>0.684</td>
</tr>
</tbody>
</table>

PV Projects

<table>
<thead>
<tr>
<th>System Size</th>
<th>Financing Source</th>
<th>Currency</th>
<th>Fit Rate</th>
<th>Fit Review</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential (&lt;10 kW)</td>
<td>Soft loan (4%) from Ministry of Finance</td>
<td>EGP</td>
<td>0.848</td>
<td>200 MW or 2 years whichever comes first</td>
</tr>
<tr>
<td>&lt; 500 kW</td>
<td>Soft loan (4%) from Ministry of Finance</td>
<td>EGP</td>
<td>0.901</td>
<td>200 MW or 2 years whichever comes first</td>
</tr>
<tr>
<td>500 kW - 1 MW</td>
<td>Domestic and Foreign Financing</td>
<td>USD</td>
<td>0.136 (or equivalent to EGP 0.707)</td>
<td>200 MW or 2 years whichever comes first</td>
</tr>
<tr>
<td>2 MW - 5 MW</td>
<td>Domestic and Foreign Financing</td>
<td>EGP</td>
<td>0.1025</td>
<td>200 MW or 2 years whichever comes first</td>
</tr>
</tbody>
</table>

6,000 rooftop isolated PV systems have been erected in remote areas, and this number is expected to hit around 7,300 in the near future.

Growing Energy Demand in Algeria and Morocco

The interests driving the initiatives to develop renewable energy in Algeria and Morocco reflect the diverse nature of renewable energies to address the economic and socio-cultural challenges the two North African countries are facing—from internalising the risk arising from the supply and demand gap, to increasing demand for development sustainability.

With the young population in Algeria and Morocco expected to grow, and the expansion of their middle-income class population, there will be increasing demand for energy consumption. Algeria and Morocco will also be competing with any number of emerging economies for the very same resources. These two nations' collective energy consumption may account for less than one per cent of the world's total, but electricity consumption per capita grew at an average of 5.69 per cent in Algeria and 5.08 per cent in Morocco between 2003 and 2012, faster than the average of Middle East and North Africa (MENA) developing economies (Figure 1).

Figure 1: Growth in Electricity Consumption Per Capita, 2003–12 (%)

Source: Author’s own calculations based on the World Bank’s Global Development and Financial Indicators.
Potential of Renewable Energy

Algeria and Morocco have sufficient renewable energy capacities to satisfy their growing energy demand. Owing to their geographical location and vast land size, these nations possess some of the highest potential and capacity to accommodate the development of renewable energy in the region. They enjoy approximately 3,500 potential hours of direct sunlight every year, and receive a wind speed of six to seven miles per minute, thus making them one of the world’s most well-endowed regions with natural renewable energy resources. Morocco’s longitudinal geographical shape, with an approximately 3,500-km coastline on the Atlantic Ocean, and could alone receive potentially more than 2,300 kWh/m² of solar irradiation and wind power of about 5,290 TWh (OECD 2013: 111) annually. Equally, Algeria could potentially absorb an annual 2,500 kWh/m² of solar energy from the atmosphere, though it receives only 35 TWh of wind energy.

Renewable energy is certainly not new in Algeria and Morocco. As early as 1982, Morocco established the Centre for the Development of Renewable Energy to provide a variety of mechanisms to promote renewable energy. The Moroccan Agency for Solar Energy (or MASEN), focuses solely on developing solar energy. In 1985, Algeria also established the National Agency for Promotion and Rationalisation of Energy Use. By mid-2000, both countries had gained traction in the international sphere, and they received active support from the US government, European Union, United Nations, World Bank, and the African Development Bank, as well as from private industrial consortiums such as Germany’s Desertec Industrial Initiative (DII), and France’s MEDgrid.

According to the International Energy Agency (IEA), Algeria aims to generate 20 per cent of its electricity from renewable energy sources by 2030; while Morocco has set a target of 42 per cent by 2020. To meet these goals, Algeria must increase its share of renewable energy at an annual average rate of 1.05 per cent between 2013 and 2030; and for Morocco, 4.17 per cent between 2013 and 2020. Currently, solar and wind power account for 14 per cent of Algeria’s total installed renewable power capacity, and 32 per cent of Morocco’s (Figure 2). More specifically, according to the REN21’s Renewables Status Report 2015, Algeria aims to install 13.5 GW of solar PV and 2 GW of CSP, as well as 5 GW of wind energy by 2030; and Morocco aims to install 2 GW of solar PV and CSP, and 2 GW of wind power by 2020. Algeria has, however, so far only installed 2 MW solar photovoltaic, 25 MW CSP, and 10 MW wind capacity in 2014; and Morocco has reportedly installed 40 MW of solar energy, and 787 MW wind energy (Figure 3).

### Table 1: Installed Solar and Wind Power Targets and Progress

<table>
<thead>
<tr>
<th>Country</th>
<th>Technology</th>
<th>Installed Capacity in 2014</th>
<th>Target</th>
<th>Distance from target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>Solar PV</td>
<td>2 MW</td>
<td>13,500 MW in 2030</td>
<td>13,498 MW</td>
</tr>
<tr>
<td></td>
<td>CSP</td>
<td>25 MW</td>
<td>2,000 MW in 2030</td>
<td>1,975 MW</td>
</tr>
<tr>
<td></td>
<td>Wind</td>
<td>10 MW</td>
<td>5,000 MW in 2030</td>
<td>4,990 MW</td>
</tr>
<tr>
<td>Morocco</td>
<td>Solar</td>
<td>804 MW</td>
<td>2,000 MW in 2020</td>
<td>1,196 MW</td>
</tr>
<tr>
<td></td>
<td>Wind</td>
<td>1,771 MW</td>
<td>2,000 MW in 2020</td>
<td>229 MW</td>
</tr>
</tbody>
</table>

To achieve the targets, Algeria has to increase its installed solar and wind power capacity by an annual average of 1.28 GW between 2014 and 2030; or 123 MW of CSP, 844 MW of solar PV, and 312 MW of wind power. By comparison, Morocco is only 1.43 GW away from its 2020 targets for installed solar and wind power capacity (Table 1).

Aside from targets, Algeria and Morocco have also put in place various mechanisms to encourage solar and wind energy development. Algeria currently has a feed-in-tariff scheme for solar photovoltaic installation, solar photovoltaic plants for over 1 MW, solar parks with minimum 5 MW, wind farms for over 1 MW, and a capital subsidy for construction of a solar thermal plant. Morocco, on the other hand, uses an overarching mechanism to promote renewable energy development: it employs net-metering, and provides public investments.

**Current Share of Renewable Energies and Existing Barriers for Deployment**

Despite the abundance of natural renewable energy resources, the use of it in generating electricity did not gather pace until the start of the millennium. The share of renewable sources in electricity production, excluding hydropower, remains insignificant—it has grown from a regional average of 0.19 per cent in 2000 to 1.02 per cent in 2012.\(^1\) Based on the latest data available, in 2012, Algeria generates a meagre 1.08 per cent of its electricity from renewable energy sources;\(^2\) and Morocco generates 8.63 per cent (Figure 4).

![Figure 4: Energy Production Mix, 2012](image)

Source: Author’s own calculations based on the World Bank’s Global Development and Financial Indicators.

Some of the reasons behind the slow development of renewable energy sources in the region include: the existing subsidies on conventional energy sources, and low levels of private investment in renewable energy projects.

According to the International Energy Agency (IEA), Algeria’s average subsidy rate for all fossil-fuel sources was 77.5 per cent in 2013, and it was ranked among the top 10 per cent of the 40 economies listed.\(^3\) Algeria’s heavy subsidies are likely a response to its abundant reserves. Unlike Algeria, Morocco imports over 90 per cent of its energy, thus making it more vulnerable to price speculation in times of short supply and high demand.

Despite the efforts and proven potential, investment in renewable energy development in Algeria and Morocco remains meagre on a global level. In 2012, the MENA region collectively received USD 2.87 billion of new investment in renewable energy,\(^4\) representing an insignificant 1.12 per cent of the world’s total new investment in renewable energy; of which 66 per cent went to Morocco. Algeria received only USD 33 million of new investment in renewable energy in 2011.

The investment trend in renewable energy is still very much driven by the business climate. In September 2015, the **Renewable Energy Country Attractiveness Index (RECAI)**, published quarterly by Ernst & Young, ranked Morocco 23rd among the top 40 most attractive countries for investment in renewable energy. This is an improvement from 32nd place in May 2013. CSP and solar photovoltaic technologies are Morocco’s greatest strengths, ranking 4th and 15th respectively; whereas wind technology is ranked 24th for onshore and 34th for offshore. The recent announcement of the opening of a giant solar thermal plant at Ouarzazate run by the Saudi-owned ACWA Power in December 2015 is certainly not a coincidence.\(^5\)

Algeria, on the other hand, has not made it to the list. Proven potential of renewable energy sources alone is not sufficient to achieve their development goals. The magnitude of investment required for renewable energy development could exceed the capacity of, or substantially reduce, public funds. Although Algeria and Morocco possess similar proven potential solar and wind power, the dynamics behind their developments have been different. Despite all the targets and mechanisms to promote renewable energy development, it remains a less pressing issue for hydrocarbon-rich Algeria than it is for Morocco. As renewable energy continues to develop, its returns on investments will remain lower and less immediate than those for hydrocarbons, whose technology is already in place. Such a situation, if not adjusted, will hamper the progress of renewable energy development.

1. The latest available data from the World Bank, **Sustainable Energy for All (SE4ALL) Database**, and **Global Electrification Database**.

2. **Renewable energy sources include hydroelectric**.


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**Dr Nadejda Komendantova, Research Scholar at the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria**

North Africa has some of the highest solar reserves in the world in terms of horizontal irradiation.\(^1\) This could make private investment into solar projects profitable.\(^2\) However, current foreign direct investment (FDI) into solar projects in the region is small—in fact, the region attracts the lowest amount of FDI in the world.\(^3\)

Much research has addressed the technical and economic feasibility of solar projects in the region.\(^4\) However, the number of papers that examine the decision-making processes and human factors is significantly lower.\(^5\) In this article, the fundamental premise is that understanding how foreign direct investors take decisions is crucially important for large-scale deployment of solar power, which requires...
not only public but also private capital. This decision-making process can be influenced by cognitive and behavioural biases, which affect the investors’ perceptions of the risks for FDI into solar projects in the region.

The risk perception of a stakeholder is a combination of the perceived likelihood of the occurrence of a negative event and its associated impact. The risk perceptions are also closely connected to how much risk people are willing to accept, and their decision whether or not to invest in a certain technology. In economic theory, such behaviour is known as risk aversion, and is a feature of economic behaviour when FDI investors are hoping to minimise risk. It can mean that even if a given investment promises benefits, investors will stay away when the possibility of losing money is too large.

Findings from a number of research projects carried out with my colleagues over the last seven years show an urgent need to reduce the risks associated with FDI into solar projects. The de-risking approach should take the risk perceptions of investors into consideration because they can be a significant barrier for deployment and implementation of solar projects. Risk perceptions also impact the weighted average cost of capital (WACC), levelised cost of electricity (LCOE), and the delay cost parity of solar with fossil fuels, leading to greater investment requirements.

According to research published by Schmidt, risk perceptions matter more for FDI into renewable energies than for FDI into fossil fuels, because the initial investment costs make a significant share in the LCOE from renewables, and the costs of fuels make a significant share of the LCOE from fossil fuels. Among renewables, concentrated solar power (CSP) and photovoltaic (PV) have a significantly higher LCOE (up to USD 0.3 per kWh) due to a high share of debts, equity and capital costs.

A survey among investors dealing with CSP power projects in North Africa showed that out of nine kinds of risks (regulatory, political, revenue, technical, force majeure, financial, construction, operating and environmental), investors perceive regulatory risks (i.e. complex and lengthy bureaucratic procedures) and political risks as being the most serious for FDI. Gaining permission was seen as the most significant barrier in the CSP project cycle, in contrast to construction, operations and management.

In other research, we examined the alternative assumptions about perceived risk by changing the internal rate of return (IRR) that FDI investors expect from new CSP projects and which impacts the annual costs associated with capital infrastructure. We examined the effects of varying the IRR for CSP plants in North Africa from 0 to 20 per cent. Each curve represents a different rate that project developers must pay their investors (Figure 1).

The results show that the LCOE varies by a factor of three, dependent on the IRR and that higher IRR will delay the time at which electricity from CSP reaches cost parity with fossil fuels. For example, with an IRR of 5 per cent (i.e. very low perceived risk), CSP can become competitive with privately developed coal power by 2020.

The risk perceptions increase the LCOE of solar power. By comparing the LCOE for CSP electricity generation between North Africa and Europe, Schinko and Komendantova found that even though North Africa has substantially higher solar potential than Europe, the resulting LCOE for Europe (USD 0.25/kWh) was not dramatically higher than the mean for North Africa (USD 0.21/kWh). This is due to substantially lower financing costs in Europe than in the North African region. If a CSP investor in North Africa could get project financing at a cost equivalent to that in Europe, the LCOE would increase by 51 per cent, from USD 0.25/kWh to USD 0.37/kWh.

Risk perceptions also increase the WACC, according to analysis conducted by Schinko and Komendantova, who compared the WACC for the euro area with the WACC for four North African countries (Figure 2).

![Figure 1: LCOE Curves for CSP Assuming Different IRR](Source: Komendantova, Patt and Williges (2011))

![Figure 2: Comparison of WACC for Euro Area with WACC for Four North African Countries](Source: Schinko and Komendantova, (2016))
Researchers found out that the WACC in Algeria and Egypt was 8.2 per cent, and 1 per cent lower than in Morocco and Tunisia, which can be explained by the existing financing cost gap between these four countries.\textsuperscript{16} Our results show that the WACC in the North African region is much higher than in Europe (8.2 per cent and 9.2 per cent compared to 4.1 per cent).

The higher WACC also has an impact on the LCOE of other solar technologies such as PV. Ondraczek et al.\textsuperscript{17} who developed a global map of the LCOE based on population-weighted national average solar horizontal irradiance and nationally specific WACC. The researchers found out that the countries that are attractive for solar investment are those with well-developed financial sectors rather than the strongest sunshine. They also found that the WACC varies by a factor of 8.8 between northern and equatorial countries, solar irradiance varies by a factor of only 2.3, and the LCOE varies by a factor of 4.2, assuming global average installation costs.

The de-risking approach has several benefits, not only in terms of reducing the IRR, WACC and LCOE, but also in terms of reducing the amount of public subsidies needed,

\textbf{Figure 3: Required Subsidies to Support CSP Project Development Assuming Different IRR}

which might be necessary to stimulate large-scale solar investment in developing countries. Figure 3 shows subsidy paths associated with different IRR, which are calculated until 2025.

The goal of our research was to explicitly evaluate risk perceptions and their effects on solar power investment in the North African countries. Our results showed that de-risking investment into solar projects is necessary to reduce the WACC and LCOE. The benefits of addressing the perceived risks could be enormous and could lead to a significant reduction of the costs of electricity and required investment for large-scale deployment of the projects. We recommend that a combination of financial de-risking and policy de-risking is required. The financial de-risking transfers the impacts of negative events to other parties, and includes such measures as public–private partnerships and risk insurance guarantees provided by public stakeholders to cover damages. It also offers insurance to project developers in developing countries to cover political risks such as political violence, including war and civil disturbances, government actions resulting in expropriation and repudiation of contracts, and any other government actions resulting in business losses. International finance and development agencies might also offer different financial instruments to reduce expectations of the IRR from the side of private investors, thus reducing the overall costs of the project.

As regulatory barriers are the most serious and likely risks for FDI into solar projects, policy de-risking would require the removal of regulatory barriers for investment; the streamlining of permission procedures to reduce construction delays; and improvements in government accountability and effectiveness. Special programmes on governance can increase the level of political and economic stability in the North African region, as well as improve regulatory and legal architecture and decrease risk perceptions of investors connected with the region. In contrast to financial de-risking, there is a paucity of research in policy de-risking and its effects on FDI.

\textsuperscript{1} National Renewable Energy Laboratory (NREL), Solar: Monthly and Annual Average Direct Normal (DNI), Global Horizontal (GHI), Latitude Tilt, and Diffuse Data and GIS Data at 40km Resolution for Africa from NREL (Washington, DC: NREL, 2011). See http://en.openei.org/datasets/node/494.


14 Ibid.

15 Ibid.


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**Staff Publications**

**Internationally Refereed Journals**


**ESI Policy Briefs**


**Conference Proceedings**


**Reports**


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**Staff Presentations and Moderating**

28 March  Melissa Low presented, “Climate Change and Sustainable Development Policies in Singapore” for FMS1201 Freshman Seminar: Policies for Building Sustainable Cities Lecture, NUS.

21 March  Christopher Len presented “China’s Regional Peripheral Diplomacy: An Analysis of Beijing’s Engagement with Central and Southeast Asia” at *Redesigning Asia Pacific Future Studies*, Kyushu University, Fukuoka, Japan.


18 March  Shi Xunpeng presented “Policy Implications for Improving Energy Security in East Asia” at the Economic Research Institute for ASEAN and East Asia (ERIA), Bangkok, Thailand.


10 March  Melissa Low presented “Climate Change in Singapore” for the GEM2906X Environment and Civil Society in Singapore Combined Session, The College of Alice and Peter Tan, NUS.
10 March Shi Xunpeng presented “Delivering Global Energy Governance under China’s Presidency and Beyond”, organised by the Shanghai Institute for International Studies, Shanghai, China.

9 March Melissa Low and Gautam Jindal presented ESI, Seminar “Understanding the Paris Climate Change Agreement”, held at ESI.

6 March Philip Andrews-Speed presented “China: Should We be Worried?” at the Windsor Energy Group, Annual Conference, Windsor, UK.

5 March Allan Loi presented “Climate Change and the Role of Energy Efficiency for Singapore” at the Learning & Leadership Program, organised by the Singapore Youth for Climate Action Group, held at the National Youth Breakout Area, Singapore.

5 March Philip Andrews-Speed presented “Nuclear Energy in Non-OECD Asia” at the Windsor Energy Group’s Annual Conference, Windsor, UK.

4 March Liu Xiyeng presented “How Far and How Fast Will Changes Occur in Asia?”, at the Asian Stakeholder Meeting for the Future of Electricity Utilities Project, organised by Chatham House, held at The Excelsior, Hong Kong.

2 March Allan Loi presented “Macroeconomic Assumptions, Recent Policy Developments, and Model Regression Results”, at the 2nd ERIA Working Group for Preparation of Energy Outlooks and Analysis of Energy Saving Potential in East Asia Region, organised by ERIA, held at the Phnom Penh Hotel, Siam Reap, Cambodia.


26 February Shi Xunpeng presented “Gas Trading Hubs and Transition to Hub Indexed and Destination Flexible Contracts in East Asia”, at the 3rd Asian Energy Modelling Workshop, organised by ESI, held at Hotel Jen, Singapore.

26 February Su Bin moderated the symposium on “COP21 Paris Agreement and Pathways towards a Low-Carbon World” at the 3rd Asian Energy Modelling Workshop, organised by ESI (see above).

25 February Victor Nian moderated the second session at the 3rd Asian Energy Modelling Workshop, organised by ESI (see above).


21–23 February Philip Andrews-Speed moderated at a Konrad Adenauer Stiftung workshop entitled, “Challenges Facing the Electricity Industry”, held in Hong Kong.

18 February Gautam Jindal presented “Frequency Balancing Challenges for Variable Energy Resources” at ESI’s Conference on the Value of Solar PV for Singapore, held at Hotel Jen, Singapore.

18 February Melissa Low presented “Climate Change: Challenges and Opportunities for Small Island States” at Meridian Junior College, Singapore.

17 February Melissa Low moderated ESI Seminar, “Climate Change and Energy Policies of the European Union”, delivered by Dr Paulina Szyja, Lecturer, Department of Economy and Economic Policy, Pedagogical University of Cracow, held at ESI.

16 February Shi Xunpeng presented “Gas Hub Development and Pricing Transition in Europe: Lessons for East Asia” at the 5th International Association for Energy Economics (IAEE) Asian Conference, organized by IAEE, held at the University of Western Australia, Perth, Australia.

3 February Melissa Low presented “Overview of COP21 Outcomes” and moderated the ESI–Office of Environmental Sustainability Post-Paris COP21 Dialogue, held at NUS.


9 January Shi Xunpeng presented “Oil Price Shocks, Market Distortion and Output Growth: Theory and Evidence from China”, at the 12th International Conference, organised by the Western Economic Association International (WEAI) and School of Humanities and Social Sciences, Nanyang Technological University (NTU), Singapore.

7 January Shi Xunpeng presented “Impact of East Asia’s Transition to Hub Pricing and More Flexible LNG Contracts” at the 12th International Conference (see above).

Staff Media Contributions

Philip Andrews-Speed was interviewed by the Asian Oil & Gas Monitor on the oil and gas investment climate in Malaysia, 19 March 2016.

Philip Andrews-Speed was interviewed by Radio Free Asia on China’s lifting of the energy consumption cap, 16 March 2016.

Philip Andrews-Speed was interviewed by Bloomberg on the overseas investment of China’s state grid company, 2 March 2016.


Philip Andrews-Speed was interviewed by Channel News Asia on Xi Jinping’s visit to Iran, 22 January 2016.

Philip Andrews-Speed was interviewed by Energy Intelligence on Xi Jinping’s visit to the Middle East, 19 January 2016.

Philip Andrews-Speed was interviewed by Radio Free Asia on China’s oil pricing policy, 20 January 2016.

Philip Andrews-Speed was interviewed by Upstream Intelligence on offshore technology development under low oil prices, 6 January 2016.

Philip Andrews-Speed was interviewed by Thomson Reuters on Iran–Saudi tensions and oil Prices, 4 January 2016.
Recent Events

9 March, Understanding the Paris Climate Change Agreement (ESI Seminar)

ESI Research Associates Ms Melissa Low and Mr Gautam Jindal explained the key elements of the Paris Agreement, including its achievements and limitations. They also examined the next steps and possible implications for Singapore.

25 February, 3rd Asian Modelling Workshop on Carbon Pricing and Investment towards Low Emissions: Uncertainties and Potential (ESI Workshop)

The third in ESI’s series of energy modelling workshops, this event focused on the quantitative analysis of carbon pricing policy and investment in low-emission activities around the world, and the implications for Asia and the ASEAN countries.

22 February, The Rebound Effect (ESI Conference)

There were three speakers at this event held at the Ministry of Environment and Water Resources (MEWR) Hall, Environment Building. Professor Anthony D. Owen, Head of the Energy Economics Division at ESI noted that efficiency improvements have long been a strong policy pillar to reduce emissions of pollutants. However, a “rebound effect” for energy efficiency upgrades may limit the full potential of emissions reduction. The rebound effect refers to additional energy consumption resulting from energy efficiency improvements. The economic argument is that energy efficiency upgrades reduce the effective cost of energy, therefore increasing the demand and thus consumption of energy. As long as the rebound effect remains below 100 per cent, policies targeting energy efficiency remain effective. The challenge comes when the rebound effect exceeds the initial energy efficiency improvement, a phenomenon termed “backfire”. As such, estimation of the rebound effect is critical for accurate policy evaluation of national energy efficiency issues.

Dr Harry Saunders, Senior Fellow at The Breakthrough Institute, and Founder and Managing Director of Decisions Processes Incorporated, shared some of his findings from a survey he carried out of 30 sectors of the United States economy through which to gather historical evidence of rebound. Based on his analysis, he argued that the Intergovernmental Panel on Climate Change’s estimates for carbon emissions reduction are based on improper estimations of the rebound effect. Dr Mona Chitnis, Lecturer in Energy Economics, at the School of Economics, the University of Surrey, spoke on the Rebound Effects from Improved Energy Efficiency for UK households.

18 February, Value of Solar PV for Singapore (ESI Workshop)

This workshop addressed the concepts of the “value” of solar PV in liberalised electricity markets as well as business and financing models for distributed rooftop PV in Singapore. Dr Peerapat Vithyasrichareon, from the School of Electrical Engineering and Telecommunications at the University of New South Wales, shared his views on solar PV in the Southeast Asian region, including key challenges and opportunities. Professor Iain MacGill, from the Centre for Energy and Environmental Markets at the University of New South Wales, assessed the economic value and market implications of PV in the Australian National Electric Market. Mr Joseph Tay, Head of Cleantech at the Economic Development Board (EDB) shared the government’s view on the role of solar...
in Singapore. Following that, Mr Christophe Inglis who is heading the local PV developer Energetix addressed the implications of PV from the private sector’s perspective. Dr Wilfred Walsh from the Solar Energy Research Institute (SERIS) shared his views on the role of forecasting in determining the anticipated PV output. Finally, ESI’s Mr Gautam Jindal, Ms Jacqueline Tao and Dr Liu Xiying presented the findings of a recently completed ESI project on assessing the value of PV in Singapore.

17 February, Climate Change and Energy Policies of the European Union (ESI Seminar)

Dr Paulina Szyja, Lecturer in the Department of Economy and Economic Policy at the Pedagogical University of Cracow, delivered a seminar on climate change and energy policies of the European Union. She highlighted the EU’s 2030 Climate and Energy Package in the context of the new Paris Agreement signed in December 2015, and outlined the progress and challenges in achieving a green economy among various EU Member States. Specifically, she examined the positions of key countries such as Poland, a country dependent on coal for over 70 per cent of its power generation needs.


Mr Raúl Bajo-Buenestado, Graduate Fellow at the Baker Institute Center for Energy Studies and a PhD candidate at Rice University’s Economics Department, delivered a presentation on the welfare consequences for consumers of introducing capacity compensation mechanisms in restructured electricity markets. Data from the Texas ERCOT market was used to study welfare in a stylised but reasonably realistic wholesale electricity market. A two-stage game was set up in which two kinds of electricity generators, peak load and base load generators, first choose their capacity investment levels and then competed on the basis of bids in a wholesale market to sell electricity to the consumers. It was found that, for the particular case of the ERCOT market, the introduction of a capacity compensation mechanism has two countervailing effects: on the one hand, it increases average expected consumer prices. On the other, it reduces price volatility and the probability of price spikes, but increases the reliability of the system. Overall, the net impact on consumers’ welfare is positive both in a perfectly competitive market and in the presence of a certain degree of market power.

3 February, ESI–NUS Office of Environmental Sustainability Post-Paris COP21 Dialogue

ESI and the National University of Singapore’s Office of Environmental Sustainability (OES) jointly organised a dialogue on the Paris Agreement. It was the first public event held in Singapore to discuss the recent COP21. It featured an overview presentation from ESI Research Associate Ms Melissa Low, and was followed by a discussion by two students who attended COP21 and the International Alliance of Research Universities (IARU) Global University Climate Forum in Paris last December. A panel discussion ensued, comprising leading practitioners in the field, including Mr Thomas Bondiguel, First Secretary, French Embassy in Singapore; Mr Yuen Sai Kuan, Director of Corporate Affairs, National Climate Change Secretariat; and Mr Sandeep Chamling Rai, Senior Advisor on Global Adaptation Policy, WWF International. Among the audience was H.E. Jairo Hernández Millán, the Costa Rica Ambassador to Singapore, as well as City Developments Limited’ (CDL) Chief Sustainability Officer Ms Esther An.

Week-long Visit to ESI by Mr George Roe

Mr George Roe, Adjunct Research Professor with the Alaska Center for Energy and Power (ACEP), University of Alaska Fairbanks and an affiliate of the Alaska Center for Unmanned Aircraft Systems Integration (ACUASI) was hosted in Singapore by the Energy Studies Institute for one week. His visit to explore collaboration followed the signing of a Memorandum of Understanding between the National University of Singapore and the University of Alaska Fairbanks in November 2015. Mr Roe spoke on three different occasions. He spoke on climate change in the Arctic and lessons from Alaska with respect to energy for sustainable development to the general public at the National Library Building on 25 January. Commander Blake McBride of the Office of Naval Research at the US Embassy Singapore also spoke briefly about the US’ role in the Arctic Council, of which the US is Chair from 2015–17. At an ESI Seminar held at Hotel Jen on 27 January, Mr Roe shared insights into Alaska’s remote communities’ use of hybrid energy systems and the Arctic maritime industry. For both these events, the US Embassy was the event partner. In addition, on 28 January he addressed 170 students at Temasek Junior College on the realities of climate change in the Arctic. During his visit, Mr Roe had
meetings with various businesses, university researchers and government agencies.

28 January, The Realities of Climate Change in the Arctic and What We Can Do about It, Temasek Junior College

Mr George Roe examined the effects of global warming in the polar North and ways that innovative energy solutions may help tackle the problem. In particular, stand-alone energy systems used in many remotely situated villages and isolated industrial sites in the Arctic may be applicable to locations elsewhere in the world. Whether it is because of the need to relocate villages due to accelerating shore erosion related to the lower amounts of sea ice in the Arctic, or because of the need to respond to massive flooding from consistently more severe tropical storms, there is a global need for energy solutions that can use locally available renewable energy, that are both affordable and reliable, and which can be easily tailored in size and configuration to work in a wide range of scenarios.

27 January, Hybrid Energy Systems in Alaska's Remote Communities and the Arctic Maritime Industry: Local Challenges and International Opportunities, Hotel Jen

Mr George Roe outlined Alaska’s realities, which include high energy costs, fragmented electrical grid, limited road network, stranded resources and dispersed population. These realities are exacerbated by the harsh and changing climate. Using the example of Kodiak Island, which employs a combination of hydropower, wind, energy storage batteries and flywheels, Mr Roe stated that microgrids are key to having effective systems in Alaska. He added that sea ice retreat in Alaska is a major challenge in setting up and maintaining energy infrastructure. Modular power systems could provide needed energy for navigation and communications, search and rescue, and security systems that need to be in place. Mr Roe also shared other Alaskan experiences in developing hybrid energy systems and explored broader global collaboration potential related to these technologies, as well as opportunities for maritime application in light of potential growth in Arctic shipping traffic.

25 January, Climate Change in the Arctic: Lessons on Energy for Sustainable Development from Alaska, National Library Building

Mr George Roe described the manifestation of climate change in the Arctic, and their particular effects on Alaskan and other Arctic communities, such as the need to relocate villages due to accelerating shore erosion related to reduced amounts of sea ice in the Arctic, or due to massive flooding from severely worsening tropical storms. Another common challenge these remote communities face is the implementation of sustainable energy solutions. Mr Roe described the stand-alone energy systems used in Alaska’s many remotely situated villages and isolated industrial sites and argued that these could be used equally successfully in other remote locations in the world.

New Staff

Dr Monique Taylor

Dr Monique Taylor joined the Energy Studies Institute in January 2016. Previously, she spent two years as a Postdoctoral Fellow in the Public Policy and Global Affairs Programme at Nanyang Technological University, during which time she completed her book, *The Chinese State, Oil and Energy Security* (Palgrave, 2014) and taught an undergraduate course called *Global Problems and Policy*.

After spending her formative years in Egypt, the Netherlands, UK, Malaysia and Australia, Monique went on to receive her BA (Hons)/BSc (conjoint) and MA (Hons) in International Relations from the University of Auckland, New Zealand. In 2012, she received her PhD in International Political Economy from the University of Queensland, Australia. Her research interests span the disciplines of international political economy, international relations and public policy, cohering around questions of energy governance and institutional development.

Contact

- Collaboration as a Partner of ESI (research, events, etc)
- Media Enquiries
- ESI Upcoming Events
- Join ESI Mailing List

Ms Jan Lui
esilyyj@nus.edu.sg

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We welcome your feedback, comments and suggestions. The views expressed in each issue are solely those of the individual contributors.

Energy Studies Institute
National University of Singapore
29 Heng Mui Keng Terrace, Block A, #10-01 Singapore 119620
Tel: (65) 6516 2000  Fax: (65) 6775 1831
Email: esilyyj@nus.edu.sg  www.esi.nus.edu.sg