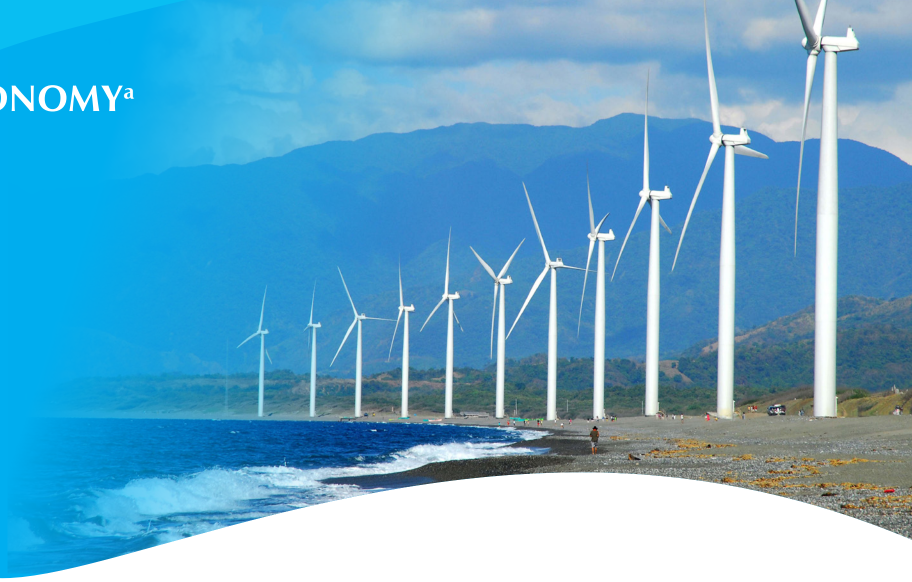
POLICY BRIEF FOR THE BLUE ECONOMY[a]

RENEWABLE OCEAN ENERGY



New and Emerging Renewable Ocean Energy Technology over the next ten years

Land-based solar and wind energy are mature forms of renewable energy (RE) technology, and they continue to improve over time. They have benefitted from favorable policies that have allowed them to advance, in some cases, to be price comparable with fossil fuels, without government assistance. Yet East Asia's unique geography increasingly points towards incorporating ocean-based renewable energy as a part of the renewable energy mix. Policy makers can rely on a blend of existing policy tools that have helped spur land (and water) based solar and wind energy to the forefront, as well as other policy tools to spur more emerging forms of ocean-based energy, in order to meet climate change related regional and national goals.

Facts and Figures: East Asia Energy Demands

- East Asia's energy demands are expected to increase by 50% due to a rapidly-growing economy
- External costs related to air pollution from the combustion of fossil fuels will increase by 35% (to US$225 billion in 2025) and energy-related CO_2 emissions are expected to increase by 61% under a business as usual scenario.[3]

International Efforts on Sound Renewable Energy

The U.N. Sustainable Development Goal (SDG) most relevant to renewable energy is SDG 13 (Take urgent action to combat climate change and its impacts), specifically SDG 13.2,[b] 13.3[c] and 13b[d]. The Paris Climate Agreement's Articles 2 and 4[1] also speak to the urgency of nations setting national CO_2 emission reduction targets and using the best available science to achieve these goals.

Europe is the global hub and testing ground for wave and tidal technologies. **The Technology Collaboration Program on Ocean Energy Systems (OES)** is an intergovernmental collaboration between 24 countries and the European Commission,[2] established in 2001 under a framework created by the **International Energy Agency**.[e] In 2017, OES released a report that summarized its members' perspectives on what policy instruments would help accelerate development of the ocean energy sector. Participants expressed preference for long-term oriented policies, and that R&D funding be risk-tolerant, with stage-gates[f] and a lifecycle assessment; they also preferred policies that "incentivize accomplishment of important R&D goals, such as a prize for continuous device performance in a real operating environment."[4] In other words, because ocean-based RE technologies are riskier than other forms of RE, policymakers should craft incentive-based policies that reward progress as certain milestones are met along the way, as opposed to policies that would revoke funding if a certain milestones are not met within a predetermined timeline, and risk leaving the project "hanging" with insufficient support to be completed.

[a] PEMSEA's definition of blue economy is a practical ocean-based economic model using green infrastructure and technologies, innovative financing mechanisms and proactive institutional arrangements for meeting the twin goals of protecting our oceans and coasts and enhancing its potential contribution to sustainable development, including improving human well-being, and reducing environmental risks and ecological scarcities (Changwon Declaration, 2012).

[b] Integrate climate change measures into national policies, strategies and planning

[c] Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning

[d] Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities

[e] Established in 1974, the International Energy Agency (IEA) carries out a comprehensive program of energy co-operation for its 29 member countries and beyond by examining the full spectrum of energy issues and advocating policies that will enhance energy security, economic development, environmental awareness and engagement worldwide.

[f] Stage-gate is a method-to launch process for managing new product development. See https://www.stage-gate.com/resources_stage-gate.php.

The European Technology and Innovation Platform for Ocean Energy (TP Ocean) identifies six essential priority areas to be addressed to improve ocean energy technology and decrease its risk profile, namely:

- Testing sub-system components and devices in real sea conditions.
- Increasing the reliability and performance of ocean energy devices allowing for future design improvements
- Stimulating a dedicated installation and operation and maintenance value chain, to reduce costs.
- Delivering power to the grid, with hubs to collect cables from ocean energy farms and bring power to shore.
- Devising standards and certification, to facilitate access to commercial financing.
- Reducing costs and increasing performance through innovation and testing.

These areas were the starting point for the Ocean Energy Forum, bringing together more than 100 ocean energy experts over two years, to develop a Strategic Roadmap.

Ocean Energy Strategic Roadmap: Building Ocean Energy for Europe

In the EU's Ocean Energy Strategic Roadmap, ocean energy development is broken down into five main development phases: R&D; Prototype; Demonstration; Pre-Commercial; Industrial; Roll-Out. For each phase of development, different technological, financing and regulatory challenges must be overcome to address the six priority areas. These challenges require actions from all stakeholders and fit-for-purpose public and private funding and financing solutions.

The Roadmap puts forward four key Action Plans focused on maximizing private and public investments in ocean energy development by de-risking technology as much as possible, ensuring a smoother transition from one development phase to another on the path to industrial rollout and a fully commercial sector.

Offshore Wind

The **UK** and other **northern European countries** lead globally on offshore wind. The largest wind farm in the world just went live in 2017 off of the **UK's** coast, made up of 175 individual wind turbines and generating 630 MW.[5] In mid-2017, a record-setting 29.8% of UK's energy was generated by RE sources, and nearly half of that clean energy came from wind alone (27% onshore, 18% offshore).[6] **Portugal** recently received assistance from the **European Commission** to support the country's innovative 25MW "Windfloat Project." Instead of being fixed to the ocean floor, these floating windmills allow the turbines to be placed farther offshore in deeper waters, to take advantage of higher wind speeds.[7]

Tidal Power

As the global leader in tidal energy, the **UK** has the geographic ability to harness 50% of Europe's tidal energy.[8] The UK's heavy investment in tidal R&D has given the country an edge in spreading the technology abroad. Its **European Marine Energy Center (EMEC)**[9] runs numerous wave and tidal energy test sites across Scotland's Orkney Islands.[10] (Neighboring **Ireland** invites global companies to test their ocean technology at its three government-funded test facilities.[11])

British companies owe much of their success to the UK's enabling regulatory structure, including a proactive approach on where to site projects, public funding, market-based incentives and the creation of the "Wave and Tidal Energy Demonstration Scheme" in 2006, which provides grants for pre-commercial demonstration of ocean energy projects.[12] The UK's investment at the national level has generated income for British companies as they explore tidal energy feasibility at home, in Europe and in East Asia. In 2017, a Scottish company completed the first grid connected offshore array of tidal energy turbines in Scotland. Its success led the company to win an EU project grant for nearly €15 million to work with others in enabling tidal energy across Europe.[13] There is also a skills-transfer component outside of the EU. In 2015, the British government allowed UK project developer SBS to transfer its tidal-stream technology from the UK to Indonesia, so that SBS and the Indonesian state-owned electricity company could construct "the first commercial-scale ocean energy power generation facility for Indonesia."[14] SBS subcontracted to Atlantis Resources of Scotland to provide the turbines and engineering resources for the three tidal energy stations to be located near Lombok and Bali, to yield about 150 MW total.[15] Expected to be complete in 2018, the 50% foreign staff are to be transitioned to 100% Indonesian staff. This could lead to another East Asian center of expertise (alongside RO Korea and China) in the field of tidal energy.

Germany competes with the UK as a European powerhouse on wave and tidal power, due to a variety of favorable policies. Its revised Renewable Energy Sources Act lowers the cost of RE and reduces reliance on fossil fuels. The Act set ambitious targets for Germany to

Foreign Direct Investment (FDI)

Transitioning to RE sources typically requires a significant financial investment. A 2017 **United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)** paper advocates for "foreign direct investment as one of the most efficient and practical ways to enhance development of the renewable energy sector" in lower-income countries, citing the "transfer of technology and expertise" to the host country and creation of "green jobs."[16] While FDI creates roughly 2 million new jobs per year, policy makers should note that it only benefits the host country if certain checks are in place—namely, that FDI is "supported by strong, transparent government institutions, focused in sectors that have high potential to link with the local economy, and takes advantage of a local labor force able to absorb knowledge and skills that can help spur a dynamic local industry."[17]

Wave Energy Not Yet Commercially Viable

Studies have shown that there is an enormous amount of potential energy to capture from wave energy,[23] which is why there has been such extensive investment in the sector. Current estimates of wave energy potential in Southeast Asia find that it is substantial albeit highly variable; the data is incomplete and there are distinctions between theoretical energy potential and what could actually be harnessed in practice.[24] While the UK could capture up to 35% of Europe's potential wave energy,[25] and it is very active in R&D and demonstration projects, the sector is "decades behind…other forms of ocean energy—and substantial money and research is still needed.[26] There is no consensus on the optimum design of the devices used to capture wave energy, and there remain maintenance challenges associated with large metal parts moving in corrosive sea water. Wave energy technology is not yet commercially viable as of 2017.

source fully-integrated RE for 35% of its overall energy consumption by 2020 and 80% by 2050.[18] Spurred by this policy environment, the country has around 15 R&D institutes and universities that are involved in developing wave and tidal power; by 2015 the federal Environment Ministry had funded six tidal/wave pilot projects in the EU for €7 million.[19] One innovative aspect of German law is that it "expedites the approval of offshore renewable energy projects by considering authorization a nondiscretionary administrative act," meaning that projects are swiftly approved unless there is a specific reason for rejection.[9]

Regional and National Policy Efforts to Research and Scale up Renewable Ocean Energy

In Southeast Asia, the **Philippines, Thailand** and **Indonesia** have all made renewable ocean energy a part of their RE plan or portfolio.[20] **Japan** has explicitly included "wave energy, tidal energy, ocean current energy, and ocean thermal energy" as part of its 2nd Basic Plan on Ocean Policy and its demonstration projects are ongoing through March 2018.[21] Both **Singapore** and **China** are vying to be the regional hub for ocean energy R&D, much like the UK is for Europe. These proactive steps echo the recommendation of an **Intergovernmental Panel on Climate Change (IPCC)** report addressed to policymakers—that ocean energy "could benefit from testing centers for demonstration projects, and from dedicated policies and regulations that encourage early deployment."[22] **Singapore** is actively attracting foreign firms to set up regional subsidiaries and generate homegrown talent, investing in research and infrastructure development and providing a steady "customer" by requiring that the government purchase renewable power.[27] **China** wants to become a regional testing ground for wave and tidal energy, and **RO Korea** currently leads the world with the largest tidal energy plant.

Market-based Incentives and Feed-in-tariff Policies in East Asia

In East Asia, feed-in-tariff (FiT) policies—where the electric utility buys clean energy from the producer under a multiyear contract at a guaranteed rate—have been the most popular incentive employed by governments to spur the wind and solar sectors (on land and water). This guaranteed, fixed rate allows the private sector to plan projects with a known return on investment, rather than being left exposed at project completion to the going market rate for RE at that time.

The **Association of Southeast Asian Nations (ASEAN)** has set an aspirational goal of generating 23% of its energy from sustainable renewable sources by 2025 (a 2.5x increase from 2014 levels).[28] East Asian policy makers are primarily choosing market-based incentives to regulate and spur the RE sector in general. East Asian countries should not underestimate the impact that these more "traditional" policy measures could have on renewable ocean energy. The authors of a UNESCAP paper applauded the feed-in-tariff (FiT) approach to solar

[9] For example, if a proposed project would threaten safe ship navigation or harm the marine environment.

as "one of the most widely adopted subsidy-like policies to spur the uptake of indigenous renewable energy for the last two decades," and they believe that its recent adoption in half of the ASEAN countries and China has spurred "the rapid development of solar and wind energy markets."[29]

Generous policy support spurs more efficient technology, which can lead to "grid parity," i.e., when subsidies are no longer required as a mechanism to compete against fossil fuels. The Asian Development Bank has noted that only two years ago, solar relied on FiTs and is now at grid parity or cheaper than fossil fuels in many countries.[30] Many of the examples[31] demonstrate the impact that FiTs have had in solar, and when combined with other beneficial policies and grid upgrades, illustrate the parallels that could take place with ocean-derived power when FiTs and other market incentive policies are applied to tidal, wind and OTEC.

China supports FiTs for electricity from RE sources, charges energy-intensive industry higher rates for electricity and has also piloted an emissions cap and trade scheme that incentivizes low-emission energy generation technologies. It is leading the region on RE policy. In January 2017, the National Energy Administration ordered a halt on the construction of over 100 coal-fired power plants (across 11 provinces) with a combined installed capacity of over 100 gigawatts.[32] It also invested more money in renewable energy (US$1.9 billion) in 2016 than any other country in the world,[33] and it is the global leader in floating solar projects. In June 2017, China completed the largest *floating* solar power plant in the world at 40 megawatts (MW),[34] and by the end of 2017 it will finish another floating solar project that will deliver 70 MW.[35] This planned facility also has a restorative feature in that it can also *clean the water* on which it is floating.[36] Incentivizing this technology through policy could allow countries to rehabilitate polluted waterways and generate power at the same time.

Market-based Incentives in East Asia

1. **RO Korea** provides tax exemptions for biofuel, has removed a subsidy that supported coal mining, has enacted emission trading legislation and has a voluntary emission reduction program known as a tradable Renewable Energy Certificate.
2. **Malaysia** provides credit guarantees for green technologies, adopted a FiT under the country's 2011 Renewable Energy Act and introduced a net metering scheme (NEM) in 2016.
3. **Japan** assesses an emissions tax on high CO2-emitting vehicles and electricity derived from non-renewable energy sources.
4. **Singapore** invested US$700 million into public sector R&D for urban solutions and sustainability, to "strengthen Singapore's innovation capacity in areas such as clean energy, smart grids and energy storage."
5. **Thailand** provides solar projects with the highest FiT subsidies in the region and produces more solar energy than all other countries in Southeast Asia.
6. FiT program "drove solar PV development in the **Philippines** into high gear" by connecting 903 MW of PV solar by end of 2016 and NEM schemes spurred market for home-based panels.

Offshore Wind

China is swiftly installing an enormous number of offshore wind farms, bringing it to third in the world behind the UK and Germany.[37] Asia led the world in the number of new offshore wind installations in 2016, and China's cumulative wind power installations are 3.4 GW more than all of the EU combined.[38] China also has the largest number of offshore wind energy projects in the planning and construction phase and the government has a clear mandate to accelerate and promote offshore wind,[39] based on, in part, the State Oceanic Administration's 12th and 13th Five-Year Plans for Development of Marine Renewable Energy. **RO Korea**, **Thailand** and **Japan** have formed governing bodies to finance, execute and maintain, respectively, proposed offshore wind farm installations.[40]

Taiwan's Bureau of Energy in the Ministry of Economic Affairs initiated the Thousand Wind Turbines Project in 2012.[41] The goal is to install 450 onshore and 600 offshore wind turbines by 2020 and 2030, respectively; its feed-in tariff scheme also provides roughly 9 U.S. cents per kWh for onshore wind vs. 19 U.S. cents per kWh for offshore wind.[42]

Tidal Power

RO Korea's national R&D program on ocean energy resulted in the construction of tidal power, tidal current energy, wave energy and ocean thermal energy conversion power plants. The country's strategic plan for ocean energy development has a 2030 goal of supplying 11% of the country's energy from renewable sources, with 4.7% coming from renewable ocean energy. Its FiT for ocean energy applies only to tidal barrage power.[43] With this policy landscape and public investment, the most famous outcome is the tidal barrage located in Sihwa Lake—the largest in the world. Built in 2011, the "552.7 GWh of electricity generated from Sihwa tidal power plant is equivalent to

862,000 barrels of oil, or 315,000 tons of CO_2," [44] and more than doubled the amount of renewable ocean energy in the world at the time.[45]

In 2017, **China** built a US$300 million laboratory campus and has consulted with EMEC to create a **Chinese Marine Energy Center (CMEC)**[46] to follow EMEC's success and make China a regional testing facility for tidal and wave energy. In 2016 alone, the country poured over $15 million into six tidal and wave R&D projects, has had three different agencies either amend or create new regulations to promote marine RE (50 MW worth of demonstration projects by 2020) and provided market incentives to address smart grid challenges via its "Guidance on Promoting the Development of the Internet + Smart Power" to "build an intelligent system of energy consumption and improve the proportion of RE as well [as] distributed energy in the electricity supply."[47]

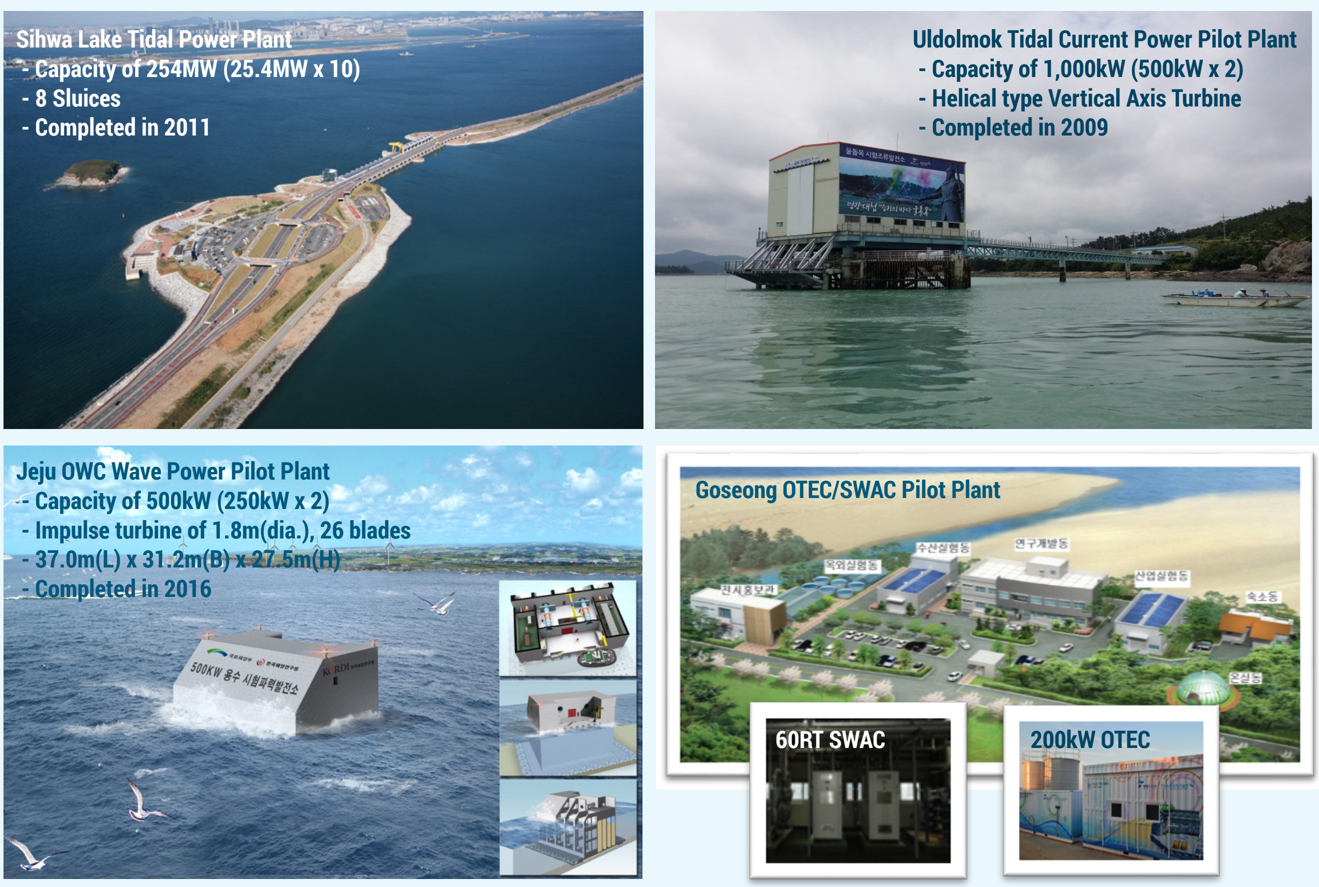
Ocean-derived Thermal Energy Demonstrations

Ocean thermal energy conversion (OTEC) technology requires that warm surface water temperatures and cold deep water temperatures have a gradient of at least 20°C, so it is primarily an option for tropical countries where these conditions are possible.[48] OTEC plants worldwide currently exist only as demonstration projects, and produce little energy (just 1 MW of power).[49] In 2013, a Chinese developer and a U.S. defense contractor partnered to create a 10-MW OTEC facility to power a resort community off the coast of **China**; the facility is still under development.[50] Public entities continue to fund OTEC technology R&D, as it is one of the few sources of renewable ocean energy that remains constantly "on" at all times.

Ocean-derived Thermal Energy

RO Korea and **Japan** have small operational OTEC plants primarily because the owners are interested in selling the proprietary technology associated with the plant, and not the electricity itself.[51] In 2011, the Philippines announced that it would have the world's first commercial OTEC facility by 2018. Unfortunately, regulators did not provide a FiT rate for OTEC, as it had done with other RE sources, thereby delaying the project indefinitely.[52]

Ocean Energy Development in RO Korea since 2000



Exploring a Policy Framework for the Renewable Ocean Energy Sector in East Asia

The aforementioned examples of policy innovations can be a foundation upon which to build a regional blue economy plan for East Asian renewable ocean energy. The plan could consider the following elements:

- Taking stock of how governments will meet their climate commitments and protect their people from pollution by evaluating RE possibilities on land and in water. More mature technologies generally benefit from market-based incentives such as FiTs. Emerging technologies generally benefit from expenditure support policies that provide capital up front, though have also benefitted from FiTs.

- Pursuing technologies that most fit with their geography and current level of expertise in the field. For example, it is far more rewarding from an environmental and economic perspective to invest in tried and true technologies such as onshore and offshore wind and solar, and possibly explore tidal energy feasibility only if geographically appropriate.

- Investing in improved infrastructure and a smart grid to ensure that these variable and distributed sources of renewable energy can be used to their fullest potential.

- Supporting research in RE to substantiate investments in commercial options, including commercial-scale wave or OTEC energy.

REFERENCES

1 United Nations. "The Paris Agreement." 2016. Available at: http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf [Accessed 2017 October 22].
2 OES (Ocean Energy Systems). "Who is OES?" Available from: https://www.ocean-energy-systems.org/about-us/who-is-oes-/ [Accessed 2017 October 22].
3 IRENA and ACE. *Renewable energy outlook for ASEAN: a remap analysis*. Abu Dhabi: International Renewable Energy Agency (IRENA), and Jakarta: ASEAN Centre for Energy (ACE), 2016.
4 OES (Ocean Energy Systems). "Ocean energy policies: Lessons learnt. Workshop IV Report. Ocean Energy Systems Information Exchange Workshop." 2017. Available at: https://www.ocean-energy-systems.org/news/ocean-energy-policies-lessons-learnt-/ [Accessed 2017 October 22].
5 Nathan, Stuart. "The big project: London array." The Engineer, 2012 June 25. Available from: https://www.theengineer.co.uk/issues/25-june-2012/the-big-project-london-array/ [Accessed 2017 October 22].
6 RenewableUK. "New renewable energy record set: 30% of all UK electricity from clean sources." 2017 September 28. Available from: http://www.renewableuk.com/news/367742/New-renewable-energy-record-set-30-of-all-UK-electricity-from-clean-sources.htm/ [Accessed 2017 October 22].
7 European Commission. "State aid: Commission authorises Portuguese demonstration scheme for ocean energy technologies." Press release, 2015 April 23. Available from: http://europa.eu/rapid/press-release_IP-15-4836_en.htm [Accessed 2017 October 22].
8 RenewableUK. "Ocean energy race: The UK's inside track." Available at: https://c.ymcdn.com/sites/renewableuk.site-ym.com/resource/resmgr/publications/OER_inside_track_final_-_onl.pdf [Accessed 2017 October 22].
9 European Marine Energy Centre (EMEC) Ltd. 2017. http://www.emec.org.uk/.
10 European Marine Energy Centre (EMEC) Ltd. "Our sites." 2017. Available from: http://www.emec.org.uk/about-us/our-sites/ [Accessed 2017 October 25].
11 Sustainable Energy Authority of Ireland. "About us." 2017. Available from: http://www.seai.ie/Renewables/Ocean-Energy/Ocean-Energy-Explained/ [Accessed 2017 October 25].
12 Portman, M. E. "Marine renewable energy policy: Some US and international perspectives compared." *Oceanography*, 2010, 23(2):98-105. Available at: http://portman.net.technion.ac.il/files/2009/11/Oceanography_23-2_portman.pdf [Accessed 2017 October 25].
13 Ross, K. "Nova Innovation leads €20m European tidal energy project." Power Engineering International, 2017 July 7. Available from: http://www.powerengineeringint.com/articles/2017/07/nova-innovation-leads-20m-european-tidal-energy-project.html [Accessed 2017 October 25].
14 Dahuri, R. and M. J. Spencer. "Ocean energy for sustainable development." The Jakarta Post, 2016 April 13. Available from: http://www.thejakartapost.com/academia/2016/04/13/ocean-energy-for-sustainable-development.html [Accessed 2017 October 25].
15 Subsea World News. "Atlantis, SBS Collaborate on Tidal Project in Indonesia." Available from: http://subseaworldnews.com/2017/03/29/atlantis-sbs-collaborate-on-tidal-project-in-indonesia/ [Accessed 2017 October 25].
16 Masato, A., C. L. M. Branchoux and J. Kim. "Renewable energy sector in emerging Asia: Development and policies." TIID Working Paper No. 01/17. Bangkok: ESCAP Trade, Investment and Innovation Division, 2016. Available at: http://www.unescap.org/sites/default/files/TIIDWP-Renewable-Energy-Sector.pdf [Accessed 2017 October 25].
17 Hornberger, K. "FDI is a global force, but is it a force for good?" The World Bank Group, 2011 March 24. Available from: http://blogs.worldbank.org/psd/fdi-is-a-global-force-but-is-it-a-force-for-good [Accessed 2017 October 25].
18 Bard, J. and F. Thalemann. "Germany: Ocean energy policy." In *Ocean Energy Systems Annual Report 2015*. Available from: https://report2015.ocean-energy-systems.org/country-reports/germany/ocean-energy-policy/ [Accessed 2017 October 25].
19 Bard, J. and F. Thalemann. "Germany: Research and development." In *Ocean Energy Systems Annual Report 2015*. The Executive Committee of Ocean Energy Systems. Available from: https://report2015.ocean-energy-systems.org/country-reports/germany/research-and-development/ [Accessed 2017 October 25].
20 Srikanth, N. "Barriers to ocean technology adoption and role of policies & institutional system to promote in Asia." 2014. Available at: http://www.icoe2014canada.org/wp-content/uploads/2014/11/3-Srikanth-Halifax-presentation-v10.pdf [Accessed 2017 October 25].
21 Brito e Melo, A. and J. L. Villate, eds. "Ocean Energy Systems annual report 2016." The Executive Committee of Ocean Energy Systems. Available at: https://report2016.ocean-energy-systems.org/ [Accessed 2017 October 25].
22 IPCC. "Summary for policymakers." In *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*. Edited by Edenhofer, O., R. Pichs Madruga, Y. Sokona, K. Seyboth, P. Matschoss, S. Kadner, T. Zwickel, P. Eickemeier, G. Hansen, S. Schlömer, and C. von Stechow. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2011. Available at: https://www.uncclearn.org/sites/default/files/inventory/ipcc15.pdf [Accessed 2017 October 25].
23 Jacobson, P. T., G. Hagerman, and G. Scott. "Mapping and assessment of the United States ocean wave energy resource." No. DOE/GO/18173-1. Electric Power Research Institute, 2011. Available at: https://www1.eere.energy.gov/water//pdfs/mappingandassessment.pdf [Accessed 2017 October 25].
24 Srikanth, N., 2014.
25 RenewableUK, *Ocean energy race*.
26 Levitan, D. "Why wave power has lagged far behind as energy source." Yale Environment 360, 2014 April 28. Available from: http://e360.yale.edu/features/why_wave_power_has_lagged_far_behind_as_energy_source [Accessed 2017 October 25].
27 Srikanth, N., 2014.
28 IRENA and ACE, 2016.
29 Masato, A., C. L. M. Branchoux and J. Kim, 2016.
30 Asian Development Bank. "Floating solar on the move in Asia." Asian Development Bank Blog, 2017 June 7. Available from: https://blogs.adb.org/blog/floating-solar-move-asia [Accessed 2017 October 25].
31 Ho, Eric. "Solar power development in Southeast Asia." Asian Power, 2017 August 8. Available from: http://asian-power.com/regulation/commentary/solar-power-development-in-southeast-asia [Accessed 2017 October 25].
32 Reuters. "In latest move, China halts over 100 coal power projects." Reuters, 2017 January 17. Available from: http://uk.reuters.com/article/us-china-coal-idUKKBN151090 [Accessed 2017 October 25].
33 Brandon, Simon. "China just switched on the world's largest floating solar power plant." World Economic Forum, 2017 June 2. Available from: https://www.weforum.org/agenda/2017/06/china-worlds-largest-floating-solar-power/ [Accessed 2017 October 25].
34 *Ibid.*
35 Bellini, E. "Ciel & Terre starts construction on the world's largest floating PV plant." PV Magazine, 2017 June 27. Available from: https://www.pv-magazine.com/2017/06/27/ciel-terre-starts-construction-on-the-worlds-largest-floating-pv-plant/ [Accessed 2017 October 25].
36 Ciel & Terre International. "Hydrelio Techonology." Available from: http://www.ciel-et-terre.net/hydrelio-technology/ [Accessed 2017 October 25].
37 Power Utility. "Flurry of offshore wind energy projects sweep Asia off its feet as costs keep falling down." Asian Power, 2017 June 1. Available from: http://asian-power.com/power-utility/exclusive/flurry-offshore-wind-energy-projects-sweep-asia-off-its-feet-costs-keep-fall [Accessed 2017 October 25].
38 *Ibid.*
39 ReportBuyer Ltd. "Offshore wind energy market - Asia Pacific industry analysis, size, share, growth, trends, and forecast 2017 – 2025." Available from: https://www.reportbuyer.com/product/4951670/offshore-wind-energy-market-asia-pacific-industry-analysis-size-share-growth-trends-and-forecast-2017-2025.html [Accessed 2017 October 27].
40 *Ibid.*
41 Thousand Wind Turbines Project. "Moving from onshore towards offshore, opening up a new blue Ocean Strategy." Available from: http://www.twtpo.org.tw/eng/offshore/ [Accessed 2017 October 27].
42 Thousand Wind Turbines Project. "Policy and Promotion of Offshore Wind Power in Taiwan" [Presentation]. Available at: http://www.re.org.tw/Files/file/01%20%E5%8F%B0%E7%81%A3%E9%9B%A2%E5%B2%B8%E9%A2%A8%E9%9B%BB%E6%94%BF%E7%AD%96%E6%8E%A8%E5%8B%95.pdf [Accessed 2017 October 27].
43 APEC Energy Working Group. *Marine and ocean energy development: A guide for practitioners in APEC economies*. 2013.
44 Kim, Y. H. "Technology case study: Sihwa Lake tidal power station." International Hydropower Association, 2016 August 2. Available from: https://www.hydropower.org/blog/technology-case-study-sihwa-lake-tidal-power-station [Accessed 2017 October 27].
45 APEC Energy Working Group, 2013.
46 Whitlock, R. "EMEC supporting China Marine Energy Centre." Renewable Energy Magazine, 2017 January 13. Available from: https://www.renewableenergymagazine.com/ocean_energy/emec-supporting-china-marine-energy-centre-20170113 [Accessed 2017 October 27].
47 Brito e Melo, A. and J. L. Villate, eds., 2016.
48 Vyawahare, M. "Hawaii first to harness deep-ocean temperatures for power." Scientific American, 2015 August 27. Available from: https://www.scientificamerican.com/article/hawaii-first-to-harness-deep-ocean-temperatures-for-power/ [Accessed 2017 October 27].
49 *Ibid.*
50 Cusick, D. "Ocean thermal power will debut off China's coast." Scientific American, 2013 May 1. Available from: https://www.scientificamerican.com/article/ocean-thermal-power-will-debut-off-chinas-coast/ [Accessed 2017 October 27].
51 Icamina, P. "Tariff issues stall Philippine ocean energy project." SciDev.Net's South-East Asia & Pacific desk., 2016 June 23. Available from: http://www.scidev.net/asia-pacific/energy/news/tariff-issues-stall-philippine-ocean-energy-project.html [Accessed 2017 October 27].
52 *Ibid.*

PEMSEA

PEMSEA Resource Facility

Tel: (+632) 929-2992
Fax: (+632) 926-9712

info@pemsea.org
www.pemsea.org