GREEN ENERGY GOVERNANCE IN URBAN SECTORS : CURRENT POLICIES, PARTNERSHIPS AND IMPLICATIONS ASSESSMENT

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Introduction

It is of increasing importance to note that the current international community has been experiencing human-induced climate change, and its impacts are becoming more prevalent over time (IPCC 2019). Stern (2006) stated that the potential risks from climate disaster could take up to 20 percent of global GDP without any actions, one percent if the right actions in place. Therefore, pursuing sustainable development and green growth is crucial for the current generation and coming generations to live lives as humans with inborn dignity. Actions from cities and other subnational actors can expedite the adaptation and mitigation process as 60 percent of the global population, including one of youth, reside in the urban environment. Renewable energy is key to the global efforts. Beyond the national, transnational level, renewable energy is building its position up to the agenda of tackling climate change in the urban sector. In this regard, the 8th International Renewable Energy Conference (KIREC Seoul 2019) held on 23 October 2019 in Seoul, Korea, shed light on discussing the renewable transformation within municipalities. Invited speakers in the session entitled “Cities: Their Roles in Advancing the Renewable Energy Sector Transformation” discussed efforts and obstacles in urban renewable transformation, and possible solutions. Attentive to the cooperation among government entities and businesses, research results on the renewable energy policies and relevant interactions in Korea were noticed. The multilateral collaboration has great influence in making changes to current regulations for renewable energy, which requires knowledge and skills of citizens (IRENA 2016). Raising public awareness is helpful in scaling up renewable energy acceptance and increasing equity in the distribution of the benefits and costs (IPCC 2011). Knowledge also enables citizens to overcome the uncertainty of development trends and changing energy governance (ibid). For Seoul, it has been essential for the city to have citizen awareness raised through campaigns and online resources as a climate adaptation strategy. Regarding the positive impacts, this report is written after

attendance to the discussion to increase the awareness of Seoul's renewable energy governance and partnerships. The objective of this literature is to go beyond the discussions to report on how cities and other non-state actors are involved in the decision-making process of the renewable energy transition. Therefore, this report will present Seoul as a case study of a city with institutional changes regarding renewable energy transition.

Current Needs of Green Energy Transition

The Intergovernmental Panel on Climate Change (IPCC) defines Renewable Energy (RE) as "any form of energy from solar, geophysical or biological sources that is replenished by natural processes at a rate that equals or exceeds its rate of use (IPCC 2011, p. 38)." Fossil fuels proved the lack of security as an energy source that also fulfills environmental sustainability when society needs energy that is secure, affordable, and environmentally sustainable. RE, on the other hand, helps the global population of 1.4 billion access secure energy source, one of the sources is, namely, biomass. As such, demand for energy has been increasing rapidly in recent years, taking up to around 13 percent of the total global energy supply in 2008. With the expansion of decentralised grids contributing to energy supply, the demands from the developing countries have also been increasing (ibid). RE contributes to sustainable development to a large extent with reducing carbon emissions that mitigate climate change, enhancing energy security, and promoting employment opportunities, which correlate with Goal 13 "Climate Action", Goal 7 "Affordable and Clean Energy", and Goal 8 "Decent Work and Economic Growth" of the UN Sustainable Development Goals. Specifically, access to clean energy lays the foundation of human development, namely, health, education, gender equality, and physical safety. Therefore, a reasonable amount of energy is required to meet the standard of living. Indeed, the possibility of such an energy transition rests on the costs currently in the developing world, which

affect the reserved finance for development. Economic costs itself of RE exceed those of fossil fuels, and the costs can vary geographically, leaving developing economies a doubt in transitioning into green energy that aids in stability in spending with spatial diversity of energy exporters. Hence, there is a need for the international community to take a burden-sharing scheme into consideration of actors by which the costs of RE would be born. However, easier employment of RE is expected with the overall decline of RE technology costs. Other obstacles in installing RE in the developing world include socio-cultural discrepancies in adopting the process, low public awareness, and limited skills and systems to bring the changes (ibid). An international framework such as Clean Development Mechanism (CDM) is required to deal with political ineffectiveness and enable capacity building in rural economies (UNFCCC 2012).

In a historical context, the primary development of a state required a sizeable amount of non-renewable energy to be consumed for the manufacturing industry. However, there has been an array of aberrant evidence of development that achieved less energy for faster development or more energy than usual used for slower development, lessening the significance of energy in the process. In such regard, necessity should be recognised in putting forward measures that decouple the global economic system from energy use in the current climate governance on the condition that states gradually expand access to RE (IPCC 2011).

Cities Needs in Renewable Energy Transition

Urbanisation is unavoidable for economic development in today's economic systems, so national governments put efforts to direct population flow into their cities along with the installation of infrastructure (Fox 2017). Currently, half of the global population resides in cities. With such migration trends, energy use in cities has increased considerably (IRENA 2016). Cities are responsible

for 70 percent of CO2 emissions, and the spatial vulnerability from climate change is high, as 90 percent of them are located in coastal areas. Not least of urban environmental problems is air pollution, most of the urban population across the world suffer the low level of air quality. Energy consumption of such extent is mostly attributed to industry, buildings, and transport. Major recommendations to meet goals to reduce urban energy use include renovating old structures of buildings to be made more energy-efficient, research and development for innovative RE technologies, and developing schemes for sustainable transport in cities. Policymaking needs to predominantly consider: setting policies from pre-assessed evidence, lowering risks of investing in RE, public sector's direct investment in infrastructure, incentivising individual actions, and provision of RE information to businesses (ibid). In particular, a city government should take into account the fact that a more densified population consumes less energy in the process of urban planning and renewable infrastructure installation. In integrating RE in urban systems, urban planning is also needed to aid in smooth integration as technical limits emerge with certain types of RE such as hydropower with limited installation by geographical location, and ensure the suitability of political situations and social issues, along with national strategic elements (IPCC 2011, p. 104).

Partnership-building among cities and businesses is needed to bring enough investments and to take collective actions. Global Covenant of Mayors for Climate and Energy (GCoM) should be invited to present an excellent example of partnership measures. GCoM brings local, regional, and city leaders together as a network to make strong actions toward climate and energy issues based on three pillars of mitigation, adaptation, and better access to sustainable energy (Global Covenant of Mayors for Climate and Energy 2018). More than 9,000 cities and municipalities are involved. According to the compiled data published through one of its initiatives, Data4Cities, local governments committed to GCoM will be able to make 1.4Gt CO2 emissions by 2030 and double the figure by 2050. It says the most reductions by 2030 will be made by intermediary cities, with a massive decrease in carbon emissions by cities dispersed in South America (ibid). Such information and knowledge sharing

initiatives help advance green energy transition as it also shares with developing countries that often show a delay in growth for lack of technology, skills, and knowledge (IPCC 2011, p. 37). It is pertinent to state that cities are required to be committed to making changes in energy supply and demand. In the process, interconnectedness among the cities is needed to promptly communicate changes in energy and climate policies through multilateral partnerships.

Case Study: Institutional Efforts of Seoul into Green Energy Transition

With climate change, South Korea has undergone extreme weather events and sea-level rise, and the damages will intensify in a wide range of sectors. Over 30 years from 1981 to 2010, the mean annual temperature has risen by 1.2 °C, the mean temperature of surrounding national waters has reported to be 1.19 °C, threefold of that of the global average (Ministry of Environment 2014). Plus, the record showed a steady increase in the number of days with heavy rain and heatwaves. It is expected that following Representative Concentration Pathways (RCPs) 8.5 scenario, the mean temperature in the Korean Peninsula at the end of the 21st century will increase by 5.7 °C. An increase in days with heatwave by around 30.2 days is also predicted. There is a potential surge of risks in sectors such as health, agriculture, forestry, water given that the population is affected physically by polluted natural assets and destroyed infrastructure with an imbalance in energy supply. Assessing the sectoral adaptation performance from 2011 to 2015, it was the industry sector that led its adaptation measures into RE. The Advanced Metering Infrastructure (AMI) has played an important role in leading industry into climate change adaptation and renewable energy transition (ibid). The application of digitised grid system has advantages including minimsing power loss and overconsumption. It also provides real time monitoring of energy supply, which attributes to the transparency (Smart Energy International 2018). Under Framework on Low Carbon and Green Growth, 17 governments of

metropolitan cities and regions and 226 local governments have formulated their specific adaptation strategies (Ministry of Environment 2014). In terms of RE transition, The Second National Climate Change Adaptation Strategies (2016-2020) allows expansion of smart grid and policy instruments to meet energy demands, developing measures to deal with the vulnerability in energy security and efficiency in cities in Korea.

Seoul's Master Plan on Low Carbon and Green Growth (2010-2030), established in 2009 to turn Seoul into a city highly adapted to climate, evaluates the vulnerability to climate-induced disasters (Seoul Metropolitan Government 2010). The annual mean temperature has increased by 2.4 °C over a century by 2007, and the centurial difference in days with tropical night recorded 60 days (ibid). Data shows that the length of spring and summer has increased whereas that of winter has substantially decreased by 2007 (ibid). However, the energy demand for heating has outweighed that for cooling. High population density in the city has cost loss of lives and economic assets, has caused urban heat island effect as well as increasing events of heat wave. Air pollution of Seoul is catastrophic, presenting increase in days with fine dust level over 35 micrograms classified as "bad" by the government, which is detrimental to human respiratory systems (McCurry 2019). Seoul is relatively vulnerable due to the high consumption of overall energy with high per capita energy use, electricity. It is important to note that previously in this report stated that high density contributes to less consumption in energy. Nevertheless, it has a close correlation with lowering resilience to an increased number of natural disasters (Seoul Metropolitan Government 2010). Energy sector in Korea has started green energy transition, starting with publishing Renewable Energy 3020 Action Plan in 2017 (Korea Energy Economics Institute 2018). High energy integration costs, coupled with low electricity cost, prevent the public in Korea from demanding the arrangement. Statistically, in the early stage of RE integration, the annual ratio of integrated solar and wind-powered energy increased by 37 and 23 percent, respectively. By 1990, a boost in solar and wind power energy take-up accounted for approximately 24 percent of electricity production through RE in Korea. About job

creation, there has been up to 17 percent of the increase in the amount invested as well as 21 percent in export amount (ibid).

Seoul's main goals regarding RE transition are 1) provision of solar panels to a million households; 2) expansion of public sector-owned solar energy sources; 3) establishment of solar-based landmark; 4) creating a basic structure to distribute solar energy (Seoul Metropolitan Government 2019). In fact, South Korea's total RE consumption reaches 26 percent of total energy consumption, and it accounts for 1.3 percent for Seoulites (In-dong and Eui-taek 2015). For the sake of better atmosphere and green energy use, Seoul institutionalised the replenishment of electric, hydropower-run automobiles with charging stations to expand the use of electricity-based transportation and make it more convenient. In 2019, it is the city government's goal to increase the number of taxis by 30 times more than 2018, triple the number of electric buses of 2018 (Seoul Metropolitan Government 2019). The government also intends to encourage changes in automobiles into electric cars financially. It has planned to expand the number of electric charging stations to 14 within select districts as well as increase the number of taxi garages and gas stations to attract more users. For public awareness, Seoul is to hold public events in the form of campaigns to promote lessening automobile use, and to communicate with citizens about hydropower and other RE installing "Hydropower House" in places of high visibility (ibid). Citizens get paid for the selection of electric cars, and some of them are expressing positive feedback for RE based cars in regards to the physical comfort, and the psychology of societal contribution, especially for the environment (Love Seoul 2019).

Seoul's renowned energy initiative named One Less Nuclear Power Plant (OLNPP) is implemented since 2011 through December 2020 (Phase 1 is from 2011-2014, Phase 2 remains from July 2014 to December 2020.) to equip Seoul with decentralised energy, better energy efficiency, and green jobs (Seoul Metropolitan Government 2019). Since nuclear energy incurs tremendous social, economic, and environmental costs, the Seoul Metropolitan Government (SMG) introduced a comprehensive energy plan whose long term goal is to reach 20 percent of energy self-sufficiency by 2020. Seoul's

energy self-sufficiency accounts for merely three percent whilst the consumption level reaches 10 percent of the national energy consumption (In-dong and Eui-taek 2015). It encourages citizens to produce energy and consume it efficiently so that it could reduce 10 million tons of GHG and cut energy consumption by four million TOE (ibid). Specifically, SMG supplied small and grid-connected devices including photovoltaics (PV) to 8,000 households in 2015. Many urban projects including "Seoul: A City of Sunlight!" project is attributed to the governmental intent. It is projected that there will be one million households to be given mini solar units, reducing 540,000 tons of GHG. The R&D for suitable application of grids into households will be fostered. Within the city, unused spaces and streets will be exploited for installing self-sufficient devices to produce more energy and render citizens a sense of energy transition. On the welfare side, through Sunlight Generation Citizen Fund, citizens are enabled to directly make funding from income from private power generators such as PVs which were grown by size of KRW 10 billion by 2018. SMG is also responsible for governing distributed energy generation and higher energy efficiency in buildings by which 56% of total energy in the city is consumed. According to reports from Building Retrofit Project (BRP), stricter environmental impact assessment (EIA) inside buildings will be reinforced. The capital city also replaced around two million lighting fixtures in public buildings and those attached to street lights with LED. 100 percent in the public sector, 65 percent of lighting in the private sector, which is about 30 million lighting units. With the start of Building Retrofit Building (BRP) at Phase 1, building owners are financially supported as loans with interest rate of around two percent annually up to KRW two billion for single buildings, KRW four billion for collective buildings over eight years to conduct the installation of energy-saving facilities (Seoul Metropolitan Government 2015a). As part of BRP, SMG has been retrofitting old and energy-hogging buildings for the old and disadvantaged and the profit from the saved energy is reinvested for social welfare (ibid).

Seoul has also placed emphasis on aspects such as innovation in business and social structure, and energy-sharing community building through Phase Two of ONLPP. SMG has been committed to

create jobs and innovation in business ecosystem with the aid of geographical, institutional measures. In fact, out of 10,000 businesses involved, most of them are small and medium-sized enterprises (SMEs) (In-dong and Eui-taek 2015). The efforts from Phase 1 regarding investment in energy products were limited, so investment advanced continuously. As a result, new facilities offset limited skills in Building Energy Management System (BEMS) and ICT technologies were built. G-valley, located in Guro District of Seoul, Mid-South of Seoul, where IT business network is ubiquitous, has high potential for regional expansion to involve ICT services which include technologies in mobility, Artificial Intelligence (AI), 5G, and green architectural services along with local governments and research institutions that help advance the industry. SMG has planned to choose 70 social enterprises in initial stages of development to consult them on self-efficiency with provision of KRW 300 million in the project. In the city energy hub centres with different regions will be situated. Those facilities will run for energy equipment management, monitoring, BEMS. They have great potential to promote jobs in the energy sector especially within metropolitan areas (ibid).

Energy Efficiency Improvement (Unit: case)

Sector	Performance
Energy Consumption	352,098
BRP	192,304
LED	201,252
Transport	123,370
Total	869,024

Energy Reduction (Unit: 1,000 TOE)

Category	Target	Reduction Achieved			
		2012	2013	2014	Total
Energy Production	410	35	78	147	260
Energy Efficiency	1,110	145	328	396	869
Energy Saving	480	151	515	245	911
Total	2,000	331	921	788	2,040

Energy Production (Unit: case)

Category	Production
Power Generation (PV, Fuel Cell, etc.)	410
Waste Heat (wastewater, incineration), geothermal	119,218
Environmental Impact Assessment	82,912
Total	259,533

Energy Saving (Unit: case)

Category	Details	Savings
Waste	Eco-Mileage System, Building Indoor Temperature Regulation	777,376
Public Sector	Public sector energy conservation	55,302
Public Participation	Waste recycling	77,607
	Total	910,285

Figure 1. Recorded performance of One Less Nuclear Power Plant initiative by category (In-dong, Eui-taek 2015)

Phase 1 of One Less Nuclear Power Plant was a success in reaching its target of reducing two million TOE between 2012 and 2014. KRW 300 billion from the private sector has been invested to provide RE for 300,000 households, along with KRW 60 billion in building around 3,700 solar power stations and fuel cell stations that reached 46MW in total. A number of high-rises and other facilities for convenience take up most of Seoul's spaces, thus causing scarcity in spaces to establish energy infrastructure. At Phase 1, SMG has managed to cooperate with one of its neighbouring city of Euijeongbu City and Bucheon City in 2012 to provide up to 6,000 TOE and 47,000 Gcal of heat from the city's incineration for districts of Seoul, respectively. Owing to the arrangement, a total of 15,000 households were benefited with better heating service (Seoul Metropolitan Government 2016). In 2013, Seoul's energy consumption decrease exceeded Korea's national energy consumption by record (In-dong and Eui-taek 2015). In particular, reduction of energy in goals categorised under energy conservation was made twice as much as the amount of energy the city planned to reduce. Figure 1 proves that such performance also makes the factor remain best at reduction of energy. The active citizen participation allowed total reduction of 777,376 TOE through Eco-Mileage programme, indoor temperature control. Indeed, waste recycling done by citizens that entails transport and inefficient space use done in landfill was also spotlighted as part of energy saving (Seoul Metropolitan Government 2016). In urban sector, GHG emissions and municipal waste shows strong correlations (Global Green Growth Institute 2019). As Sudokwon Landfill example in 2011 with good performance, waste to energy (WTE) technology should be appropriately utilised. However, Phase 1 was criticised for its weak institutional framework (Seoul Metropolitan Government 2016). Phase 1 was initiated by the Implementation Council that consists of academics, policymakers, and other citizens, helping setting agenda and implementing the regulations. It was common that local governments in the city were in advancing the progress of the initiative. Also, citizen participation lacked as to energy efficiency or production as the focus of the relevant projects was made on large-scale PV power generation and fuel cell plants. Accordingly, there is a need for SMG to

improve the elements of governance where citizens proactively partake. Since energy conservation had good performance with citizens, that of energy efficiency and production with better settings will attract better citizen involvement. Whilst distributing small energy units and grid-connected devices, it is required for the public agency to take account of spatial, economic differences in profitability in decentralised energy generation. A possibility has emerged regarding compromising expected positive impacts of BRP. Rewarded for "fostering participation in public policy decision-making through innovative mechanisms" from the UN, the first step of OLNPP was overall deemed unique and comprehensive in laying foundation of urban RE transition policies for, and with its citizens. Energy welfare funding service has continued in Phase 2 as energy-sharing system in communities. SMG plans to alter the essence the basic rights as to secure energy supply, which is also reflected in SDGs Goal 7. The city has set up villages to be energy self-reliant so that they can create profits by saving energy and sharing them with other community members. The community-centred policy has bred the spread of new RE technologies and economic growth as well (Hana 2017). Such Energy Self-reliant Villages (ESVs) have reduced by around 12 percent in electricity consumption between 2012 and 2015. Similar trends of energy efficiency increase has shown through LED replacement. Energy Supermarket in some ESVs sell small PV panels and units, some made developments in a way that combined different types of energy systems. Looking globally, the government of South Korea is little supportive toward such projects in municipalities. As a collective initiative, the status of the ESVs hugely depend on economic situations - national and municipal - including those regarding public, private investment and funding. Internally, communities need adequate spirit for each community in addition to the leadership. Externally, there is a necessity for SMG and the government of South Korea to well shape the current financial, energy policies to make a successful, sustainable ESVs along with national publicisation (ibid).

Seoul's Local, Regional, Transnational Partnerships with Public and Private Sector

The role of local governments and municipalities is integral to enhance the public agenda about climate change governance and renewable energy transition, but often they are too small to get their voices conveyed at Conference of the Parties (COP) of the UNFCCC. Duggan (2019) stated that little number of collective voices is made by itself, rather done through associations between national, local governments, and other stakeholders. Whether positive or not, Seoul has had an active relationship with such associations. International Council for Local Environmental Initiatives (ICLEI) and Seoul have shared membership since 1999, SMG held ICLEI World Congress 2015. Highlighted was that Seoul Declaration that announced nine urban agendas regarding sustainability along with environmental MOUs over eco-friendly policies and technologies (Seoul Metropolitan Government 2015b).

Businesses are powerful non-state actors that influence climate and renewable energy negotiations. Examples were observed when International Air Transport Association (IATA) let the regulation of emissions sustain under the International Civil Aviation Organisation (ICAO) (Duggan 2018). With quick internal transition or acceptance of international agreements, they can accelerate the RE transition (Business and Sustainable Development Commission 2017). Energy welfare project from OLNPP in Seoul was invested up to KRW 2.2 billion for Repairs of Hope project, part of BRP. Multiple deals including MOUs with businesses and civic organisations enabled decrease of BRP execution costs. In particular, insulation provision for welfare repairing from LG was conducive to dropping major costs. Renewable Energy 100 (RE100), which was constantly mentioned in the discussion is a global movement of businesses and governing entities about producing operating energy 100 percent with their own hands. By 2019, globally, 185 businesses were involved. However, in Seoul, or in South Korea, the progress has been zero percent, anxious about the potential cost

incurred. RE100 proves that taking such responsibility decreases the risk of changing global energy cost. Not only that, future electricity cost is unpredictably high, heightening the necessity of acceptance. Seoul is a city with exceptional human resources and various infrastructure that meet citizen social and economic needs. A need for bilateral and multilateral collaboration between the city government and businesses has evolved due to the uncertainty of global changes (POSCO 2019).

According to REN 21 (2019), KIREC 2019 was the first conference that hosted both national and local government. IRECs have been built upon Bonn 2004 "Coalition of the Willing", where international actors have had an agreement upon hosting successive convenings. KIREC Seoul has depicted various policy directions of nations, cities, and businesses, tilting the discussions into the role of citizens and innovation (REN21 2019).

Conclusion

This report was written on the basis that the "facts" of Seoul's renewable energy transition and its partnerships need to further at the international stage. With an attendance of the Seoul Metropolitan Government, Seoul acted as a case study in this report. Located in the Korean Peninsula, geography increases the risks and vulnerability against climate variance, especially on the decrease in natural assets and the national population, which is not in line with high per capita energy and high population density in the city. Overall, South Korea's provision of green energy has skyrocketed with increased integration of solar and wind power energy, and SMG has accorded its policies with expanding solar-based energy. Seoul's initiatives have started early 21st century. The One Less Nuclear Power Plant initiative has evidenced that Seoul, as an influential world city, has been able to make changes to its institutions as to climate and renewable energy with the aid of various public agencies and private sector stakeholders. The local and regional governments need more proactive

policy implementation, with citizens involved. Relating to that, more robust framework regarding citizen welfare policies and decentralised energy generation is needed. The direction of policies should head towards attracting more green investment from numerous types of enterprises, for the sake of public awareness and advancing projects designed to improve energy efficiency. Indeed, partnerships among subnational sectors of South Korea are getting more active, and although new, the given energy supply policies are approaching where the city intends to go. Amidst national and global political upheavals, it is crucial that subnational actors get involved with diverse organisations and governments to influence agenda both in UNFCCC and national legal systems. As the year P4G Summit is hosted by Seoul approached, actions from subnational actors, ranging from those from urban sectors to youth are highly anticipated.

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