Top down strategy for renewable energy investment: sizing methodologies and Integrated Renewable Energy System models

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ABSTRACT: In this paper, we present a top down strategy for renewable energy investment. The proposed approach is a three-step framework. By applying the approach, renewable energy global market leaders and trends will be identified and analyzed that included: (1) economics and renewable energy policy, (2) specific renewable energy sectors that presents the most attractive investment opportunity, (3) and finally the most promising renewable energy investment vehicles for investors. Other stakeholders can also use the developed framework, such as consumers and policymakers, to make socio-economic decisions and assess renewable energy investments. This paper presents an extensive review on various issues related to Integrated Renewable Energy System (IRES) based power generation. Issues related to integration configurations, storage options, sizing methodologies and system control for energy flow management are discussed in detail.

Key words: Renewable energy, Renewable energy policy, Renewable energy investment, integrated systems, Renewable energy resources**,** Renewable energy policies

1. INTODUCTION: World energy demand is expected to growth briskly. Oil, coal and nature gas will have to supply much of that in order to meet our demand unless we can make renewable and clean alternatives more attractive to replace them. To avoid catastrophic damage to our planet and human race, it is inevitable to move to an environment with low-carbon and extensive sustainable energy sources. To fulfill environmental goals, massive financing is predicted. Concerning with limited budget from government, public, private and institutional investors play an important role for future sustainable developments. Undoubtedly, it is challenging for policymakers to create the conditions to make renewable energy attractive to investors and utilities without slowing down the attainment of other equally important developments or placing an inequitable share of the cost burden on tax payers.

In the past, penalty and reward schemes are the commonest instruments used by policymakers to promote renewable energy developments. However, not only these schemes do not necessarily align with business interests of investors, but also motivations for renewable energy developments are always initiated by governments. The global financial crisis in 2008 represents a good example to reveal the problems. According to New Energy Finance, total clean energy investment in the second half of 2008 was down 23% from the second half of 2007. During the phase in 2010, several European governments announced incentive cut for solar energy due to acutely economic recession. The supply of debt for renewable energy projects in Europe was dramatically decreased, as banks had to respond to sharp increases in their cost of funding and upgrading their assessments of the risks involved in lending to borrowers in Italy, Spain and other affected countries. Sound and prudent strategy is, therefore, extremely important to create a robust environment for government, investors and public. On the one hand, government can attract more foreign investments, lower its expenditure and improve budget planning. On the other hand, investor enjoys a better risk-reward investment profile and public enjoys improvement of social welfare benefits.

In this paper, Section 2 presents a brief review of existing renewable energy investment. Section 3 introduces the overview of top down approach. The proposed framework of the proposed approach is described in Section 4. The framework is divided into three parts and discussed one by one in this section. Finally, a conclusion is drawn in Section 5.

2. Current status of renewable energy investment

In both developed and developing countries, stakeholders have expressed concerns about the environmental impacts of electricity production and use. The regions of Asia and Oceania have attracted more than one-third of total new investment since 2009. Within the regions, Australia and New Zealand set ambitious goals and aim to achieve 100 percent and 90 percent of renewable electricity shares in 2030 and 2025 respectively. As the countries enjoy enormous renewable energy resources in the form of sunshine, wind, biomass, hot rocks and waves, they stay on track to achieving their goals. China and India, on the other hand, are benefited from capital inflow in renewable energy. With the help of fast growing economy, the two developing countries dedicate to promote renewable energy development and utilization.

In Europe, overall binding target of 20 percent share of renewable energy sources in energy consumption by 2020 is set. Each member country has its specific target For instance; Denmark, Norway and Sweden have set their targets up to 50 percent, 67.5 percent and 50 percent of energy from renewables respectively by 2020. But other countries like African countries may not pay so much attention to renewables, and that's because of low development on policies and decision making.

In Middle East and North Africa (MENA) region, contribution to renewable energy is far from satisfaction. Almost all of MENA countries contribute less than world average. Some of them, such as Oman and Qatar, even produce zero percent of energy from renewables. Only Tunisia is higher than world average, which produces 16.1 percent from renewables. Situation is, hopefully, not getting worse, as some of MENA counties have launched renewable energy development plans. For example, Morocco and Egypt plan to generate 40 percent and 20 percent energy from renewables by 2020 respectively. As one of the most important emerging markets, South Africa has launched an Integrated Resources Plan since 2010. This milestone program envisages about 42 percent of electricity generated from renewable resources by 2030.

3. Overview of top down approach

There are two major analytical approaches available in literature for predicting return, which are top down and bottom up. Top down and bottom up are strategies of information processing and knowledge ordering. In top down forecasting, analysts use macroeconomic data to produce return expectation. By contrast, bottom up forecasting begins with the microeconomic outlook for the fundamentals of individual companies to produce return expectation.

Fig. 1 shows a typical top down framework. Top down approach is a deductive reasoning and essentially breaks down of a system to gain insight into its detailing subsystems until the lowest level. A top down investing involves breaking economy and financial world into finer details. After looking at the big picture, different industrial sectors are analyzed in order to select those that are expected to outperform the market. Specific companies, projects or investment vehicles are further analyzed and those that are expected to be successful and valuable to investors are chosen as investments.

To save effort and rule out discrepant options, it is usual to define objectives and constraints at the beginning. An Investment Policy Statement (IPS) or other similar statements is common to use. It documents the procedures, investment philosophy, guidelines and constraints to be adhered to by all the parties. Therefore, those markets, sectors and investment vehicles, which do not align with objectives or violate constraints, can be discarded immediately.

3.1. Global market analysis

As top down approach begins at the top, the first step is always to analyze the world economy. At this level, we compare markets all around the world. To be more effective, it is not uncommon to establish a classification for different countries before the start of comparison. For instance, we may classify countries by geographical locations (Asia, America, Europe, Middle East and Africa), economic status (developed and developing countries) or market structures (regulated and deregulated market). Once we complete the classification, we can start to analyze the national economic indicators, such as gross domestic product (GDP), GDP growth rates, inflation, interest rates, exchange rates and electricity growth. This helps to identify the group which is expected to outperform others. Further analysis has to be performed among the countries within the selected group. Due diligence over these countries is essential. Apart from the above mentioned indicators, demographical backgrounds, political environments, business environments and other specific elements are also recommended for comparisons. After determining the country, which represents the best option, the next step is to investigate the sectors of the country.

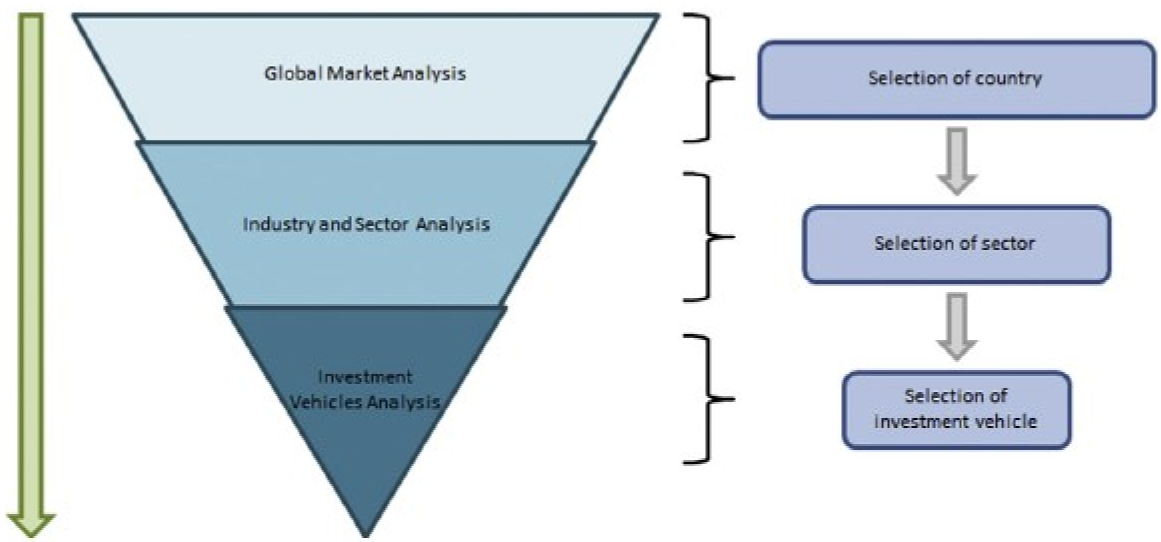

Fig. 1. Typical Top Down Framework

3.2. Industry and sector analysis

The emergence of exchange-traded funds (ETFs) and sector specific mutual funds allows the top down approach to end at this level in certain situations. For an instance, if we expect that finance sector is going to outperform in the market, we can simply buy an ETF or mutual fund which represents the sector.

3.3. Investment vehicles analysis

After identifying the sector which is expected to outperform others, we can determine the final investment vehicle which benefits investors most without violating constraints. There are numerous types of investment vehicles, including but not limited to:

- cash and cash equivalents
- fixed interest securities

- stocks
- commodities
- commercial or residential real estate
- collectibles
- insurance products
- derivatives
- foreign currency
- private equity

4. Top down strategy for renewable energy investment

The proposed top down framework for renewable energy investment is divided into three levels which are global market analysis, renewable energy sector analysis and investment vehicles analysis as shown in **Fig. 2**.

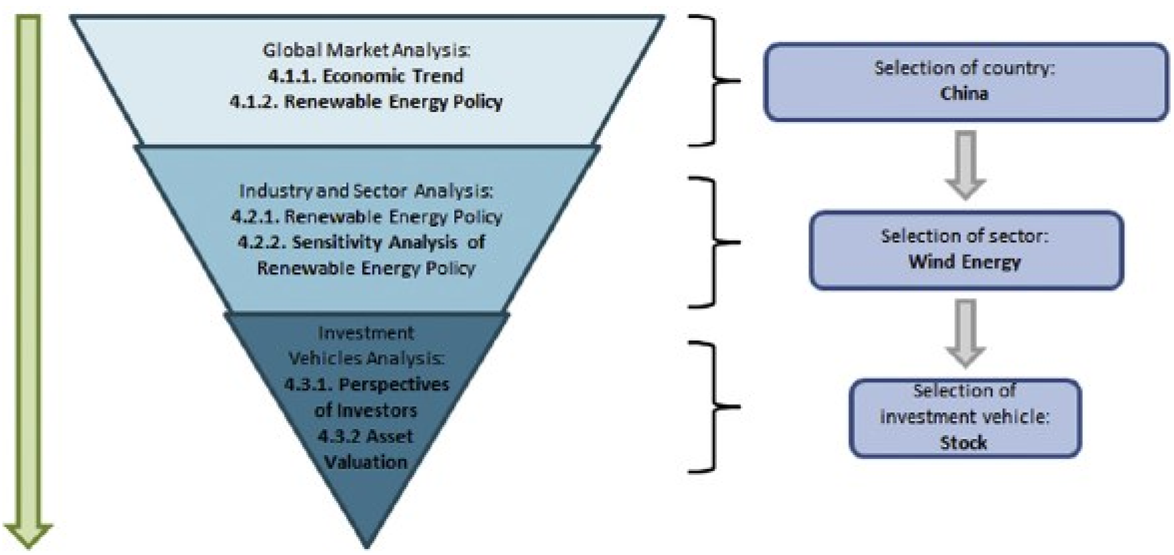

Fig. 2. Top Down Framework for Renewable Energy Investment

4.1. Global market analysis

To get a sense of the economy's health, investors generally start from economic indicators. Indicators include leading, lagging and coincident indicators which are used to reveal current economic performance and predict future economy.

Understanding both unemployment rate and population are definitely inevitable. Population is closely tied to economy and economic development. Population growth enlarges labor force which increases economic growth and domestic demand. However, a large population growth is not only associated with food problem, but also imposes population, human resources and poverty issues. Therefore, the demographic of population, population growth, population control and government policy should also be considered. Unemployment rate is another factor reflecting a country's economy. It measures the effect of economic events and is a powerful confirmation of what the other economic indicators are showing.

Apart from economic indicators, currency movement is another useful mean to predict an economy trend. The appreciation of a country's currency refers to an increase in the value and demand of that country's currency. Its opposite, a decrease of value and demand of a currency, is currency depreciation. In general, if a country's economy is in strong growth phase, its currency appreciates. And if a country's economy is in a slow growth or recessionary phase, the value of its currency depreciates.

4.2. Renewable energy policy

Politics and economics are interconnected. Governments enact fiscal and monetary policies that have direct or indirect, and positive or negative effects on the profitability. As a consequence, government policy has been always identified as one of the essential elements. Although policy designs are different in countries and states, majority of policy objectives aim to enhance diversification of electricity generation mixes, increase renewable energy involvement, reduce reliance on fossil fuels, enhance competitiveness of renewable energy sources, reduce carbon emissions or various combinations thereof. National policies Substantial policy mechanisms to support green power are in countries.

Intuitively speaking, the larger the gap between current renewable energy share and target is, the bigger the room for renewable energy investment is. Also, the stronger the commitment to achieve target is, the higher the potential for the investment is. Therefore, analysis on current renewable energy conditions and future renewable energy targets are important. Compounded annual growth rate (CAGR) is one of the tools to calculate the expected growth rate of renewable energy to fulfill its target and obligation. CAGR is formulated as:

$$\text{GAGR}=\left(\frac{future\ renewable\ energy\ share}{current\ renewable\ energy\ share}\right)^{\frac{1}{number\ of\ years}}-1 \quad (1)$$

Electricity growth rate should also be included in the above equation. Otherwise, the real growth of renewable energy is missed out. For this reason, the equation is modified as:

$$\text{Real CAGR}=\left(\frac{future\ renewable\ energy\ share}{current\ renewable\ energy\ share}\times(1+\text{growth rate})^{number\ of\ years}\right)^{\frac{1}{number\ of\ years}}-1 \quad (2)$$

Capital flow into renewable energy is another important analysis. The purpose of capital flow analysis is to trace the investment flows for renewable energy and to gauge trends in attitudes and perceptions of investors with regard to renewable energy investments, which provides greater insight into trends and ideas about the future. Statistics have been showed the new investment in renewable energy and the share of new investment over the total new investment from2004 to 2012 respectively. An estimated $244 billion was invested in new renewable energy capacity worldwide in 2012, up from$40 billion in 2004. China shows the steepest and most consistent growth in investment, from only $2.6 billion in 2004 to $66.6 billion in 2012, which indicates China has attracted more and more new capital into renewable energy sector since 2004. With the consideration of Real CARG and investment trends, it has been observed china continue its maturity and growth in renewable energy field.

5. Mathematical model for renewable energy sources

5.1. Mathematical model for wind energy system

Wind speed continuously varies at a particular site. It depends on local land terrain, weather system and height above the ground. Therefore it is necessary to capture wind speed variation in a model to forecast the energy production. Weibull probability density function best describes the wind speed variation. The weibull probability density function of wind speed (V) is expected as:

$$F(V, K, C)=\left(\frac{k}{c}\right)\left(\frac{v}{c}\right)^{k-1}\exp\left[-\left(\frac{v}{c}\right)^{k}\right] \quad (3)$$

Where f (V, k, c) is the probability of wind speed (V), c is the scale parameter, k is the shape parameter and $V\geq0$, $k>1$, $c>0$. The output of wind energy system depends on its rated power (P_r) of wind turbine, cut-in speed, cut-out speed and rated speed. Mathematically, electrical power output of wind turbine (P_{WT}) is calculated as:

$$\begin{cases} 0, & for \quad 0\leq V<V_{cut-in} \quad and \quad V>V_{cut-out} \\ aV^3 & for \quad V_{cut-in}\leq V<V_{rated} \\ P_r & for \quad V_{rated}\leq V\leq V_{cut-in} \end{cases} \quad (4)$$

Where V_{cut-in} is cut in speed, $V_{cut-out}$ is cut out speed; V_{rated} is rated speed of wind turbine. Constants **a** and **b** are function of rated speed and cut in speed of wind turbine and calculated as:

$$\alpha = \frac{P_r}{V_{rated}^3 - V_{cut-in}^3} \qquad b = \frac{V_{cut-in}^3}{V_{rated}^3 - V_{cut-in}^3} \tag{5}$$

Annual energy production (E_{WES}) from a wind turbine at a specific site can be estimated as:

$$E_{WES} = 365 \times 24 \left(\sum_{v=0}^{v\ cut-out} P_{WT} \times f(V, K, C)\right) \tag{6}$$

At a given hub height, wind speed can be calculated by using following power-law relation:

$$\left(\frac{V}{V_r}\right) = \left(\frac{h}{h_r}\right)^n \tag{7}$$

Where V and V_r are the wind speed at hub height 'h' and reference height 'h_r', n is the power-law exponent.

5.2. Mathematical model for Micro Hydro Power system

In hydro power generation, kinetic energy of water is used to rotate hydro turbine, which in turn rotate the coupled shaft and generator and this produce electricity. The power output of Micro Hydro Power (MHP) system depends on water discharge and net head available at particular site. The theoretical electrical power generated by the MHP system (P_{MHPS}) in watt is given by:

$$P_{MHPS} = 9.81\ QH_{net}\ \eta_0\ p_W \tag{8}$$

Where Q is the discharge (m^3/s), H_{net} is the net head (m), ρ_W is the water density (kg/m^3), η_0 is the overall efficiency of MHP system including the efficiency of hydro turbine, generator and brush gear.

Annual energy generated from a MHP system can be calculated as:

$$E_{MHPS} = P_{MHPS}(\,365 \times 24 \times \text{capacity factor}\,) \tag{9}$$

5.3. Mathematical model for solar photovoltaic system

The input to solar photovoltaic (SPV) system is solar radiation. SPV panels are inclined at an angle equal to the latitude of the considered area to increase the amount of solar radiation received on SPV surface. The electrical power output of inclined SPV system mainly depends on amount of beam radiation and diffuse radiation fallen on SPV surface. Total hourly solar radiation on a fixed inclined surface (H_T) can be calculated as:

$$H_T = H_b R_b + (\,H_b + H_d)R_r \tag{10}$$

Where H_T is in kWh/m^2, H_b is the beam part of solar radiation (kWh/m^2), H_d is diffused part of solar radiation (kWh/m^2), R_b is tilt factors for beam radiation, R_d is tilt factors for diffused radiation and R_r is the tilt factor for reflected part of solar radiations. Hourly power output of SPV system (P_{SPVS}) is calculated as:

$$P_{SPVS} = \eta\, H_T\, A \tag{11}$$

Where η is the conversion efficiency of SPV system, A is the surface areas of SPV system. Annual energy output of SPV system is estimated as:

$$E_{SPVS} = \sum_{i=1}^{8760} P_{SPVS} \tag{12}$$

5.4. Mathematical model for biomass gasified system

Presently, biomass gasified based power generation system is a mature technology for electrification of isolated areas. In biomass gasification, producer gas is generated when biomass is burned with insufficient oxygen. The generated producer gas is mixed with diesel in certain ration and used In diesel engine that run coupled generator to produce electricity. The hourly electrical power output of biomass gasified system depends on biomass availability and generator operating hours per day. Mathematical model of biomass gasified System is represented as follows:

$$P_{BMGS}=\frac{\text{total biomss available }(\frac{\text{ton}}{\text{year}})\times CV\times \eta\times 1000}{365\times 860\times(\text{operating hours per day})} \tag{13}$$

Where P_{BMGS} is hourly output of biomass gasified system, CV_{BM} is calorific value of biomass (4015kcal), η_{BMG} is the overall conversion efficiency of the biomass gasified system from biomass (fuel wood) to electricity production (21%).

Annual energy production of a biomass gasified based system can be estimated as:

$$E_{BMGS}= P_{BMGS}(\, 365\ \times 24\ \times \text{capacity factor}). \tag{14}$$

5.5. Mathematical model for biogas system

Biogas is produced from animal manure and human sewage. In this mode, biogas and diesel are mixed in the ratio of 80:20 to run the diesel engine that in turn rotates the coupled alternator. In remote areas, biogas is mostly used to fulfill the cooking energy needs of village household and thereafter, if any surplus biogas is available that can be used for electricity generation. The hourly power output of biogas based system depends on day. The mathematical model for biogas based power generation system is represented as follows:

$$P_{BMGS}=\frac{\text{total biogas generated }(\frac{\text{m3}}{\text{day}})\times CV\times \eta}{860\times(\text{operating hours/day})} \tag{15}$$

Where CV_{BG} is calorific value of biogas (4700kcal), η is the overall conversion efficiency of biogas system from biogas to electricity production (27%). Annual energy production of a biomass gasified based system can be estimated as:

$$E_{BMGS}= P_{BMGS}\,(365 \times 24 \times \text{capacity factor}) \quad (16)$$

6. Unit sizing and cost optimization

Optimum unit sizing is essential for efficient and economic utilization of the renewable energy sources in integrated system. Optimum sizing assures the lowest net present cost with system reliability requirement so that the system can operate at the optimum conditions. Optimal resource-need matching in an integrated system is necessary to have acceptable system cost and reliability. These planning issues are generally contradictory with each other and therefore, a reasonable trade-off between them is enviable. Oversizing the system components will enhance the system cost while under sizing leads to failure of power supply.

7. For unit sizing and cost optimization

LCE (Levelised cost of energy) is an economic evaluation tool for the energy production in integrated system which includes all recurring and non-recurring costs over project lifetime. It is defined as the ratio of the total annualized coast of system (ACS) to the annual electricity production (E_{Tital}) by the system. Mathematically, it can be estimated by the following formula:

$$\text{LCE}=\frac{ACS}{E_{Total}} \quad (17)$$

LCE can be calculated in terms of average generation cost (C_{av}) and given by:

$$c_{av} = \frac{[CRF+m]\sum_{i-1}^{N} P_i R_i}{87.6\sum_{i-1}^{N} R_i K_i} \quad (18)$$

Where C_{av} is the average generation cost ($/kWh), K_i is the load factor for ith generator, m is the operation and maintenance (O& M) cost ($/kWh), n is the payback period (in years), P_i is ith generator capital cost($/kW), R_i is the ith generator rating in kW. Capital recovery factor (CRF) can be evaluated in terms of discount rate(r) and project lifetime 'n' (in years) as:

$$CRF = \frac{r(1+r)^n}{(1+r)^n - 1} \tag{19}$$

7.1. Annualized cost of system (ACS)

The annualized cost of system is the sum of the annualized capital cost ($C_{annz\text{-}cap}$), the annualized replacement cost ($C_{annz\text{-}main}$), of all components of system:

$$ACS = C_{annz\text{-}cap} + C_{annz\_rep} + C_{annz\text{-}main} \tag{20}$$

7.2. Net present cost (NPC)

This model represents life cycle cost. The total NPC comprise of all outlay and incomes that take place in the planet life, with future cash flows discounted back to the present. The total comprise capital cost of the system components, replacement cost of component that occurs in operation period of plant, the cost of maintenance and fuel. The NPC also considers any salvage costs of components, which is the worth remained in the system components after the operation period of system. If TAC is total annualized cost and CRF is capital recover factor, NPC is calculated as:

$$NPC = \frac{TAC}{CRF} \tag{21}$$

NPC can also be calculated as follows:

$$NPC = \frac{TCO(1+i)^N}{1+ROI} \tag{22}$$

Where TCO is total capital outlay which is the sum of capital cost, operation and maintenance cost and replacement cost, ‘i’ is the annual inflation rate, N is the cumulative number of years, ROI is rate of return of the investment or market discount rate (MDR). MDR is adjusted according to the inflation rate so that all future costs arebeingdiscountedtorepresenttherealdiscountrate.Net present value (NPV) of the system is opposite in sign of NPC.

7.3. Payback period (PBP)

PBP is the time in which the initial cash outflow of an investment is expected to be recovered from the cash inflows generated by the investment. it can be calculated as:

$$PBP=\frac{\text{initial investment}}{\text{Cash inflow per period}} \quad (23)$$

7.4. Power reliability analysis

Loss of power supply probability (LPSP) is defined as being the fraction of the deficiency energy and that required by the load. LPSP can be estimated as:

$$LPSP = \frac{\sum_{t=1}^{T} LPS(t)}{\sum_{t=1}^{T} P_{Load}(t)\Delta t} \quad (24)$$

Where LPS (t) is loss of power supply at hour t, P_{Load} (t) = load demand at hour t.

In solar–wind–battery based integrated system, LPS (t) at hour't' can be calculated as:

$$LPS\ (t)= (P_{Load}\ (t) - P_{Wind}\ (t)) \times \Delta t - (P_{SPV}\ (t) \times \Delta t + SOC\ (t-1) - SOC_{min}) \times \eta_{INV} \quad (25)$$

Where, P_{Wind}(t) is wind power output, P_{SPV}(t) is PV array output and SOC (t_1) is previous state of charge of battery, SOC_{min} is minimum state of charge, η_{INV} is the inverter efficiency.

Expected energy not supplied (EENS) is the expected energy that is not supplied to the load under the condition when load exceeds generation. EENS in kWh is calculated as:

$$EENS= \sum_{k=1}^{8760} L.D \quad (26)$$

Where L is the average annual demand (kW), D is the duration (h) in which load is not meet out.

8. Discussion and conclusion

High penetrations of renewables outlooks project 50e95% energy shares by 2050. Growth of renewable energy investments have to continue in order to achieve the high-renewables projections. The objective of the paper is to presents three-level top down approach for investors to make investment decisions proactively. Unlike traditional approaches, the proposed approach aligns investors' business interests with renewable energy developments considering from their perspectives. At each level, investors are flexible to include their preferred economic and financial data or tool to search the most valuable and suitable renewable energy investment step-by-step. It is also intended to setup an effective investment framework for stakeholders to start, either when they want to replicate current, or are trying to develop new, workable investment approaches for renewable energy.

Sizing methodology is discussed for measuring integrated system components by many researchers. It is observed that various sizing methodologies have been reported in for optimizing system. However, many researches and efforts needs to be performed in renewables formulization, yet todays we can get good estimation of renewable consumption, utilizing suitable procedures and planning their position in human's life.

References

[1] Glemarec Y, Rickerson W, Waissbein O. Transforming on-grid renewable energy markets [Online]. Available at: http://www.undp.org/content/undp/en/ home/library page/environment-energy/low_emission_ Climate resilient development/transforming-on-grid-renewable-energy markets. html; 2011.

[2] Taxes and incentives for renewable energy. KPMG International Cooperative; 2012.

[3] Tang A, Chiara N, Taylor JE. Financing renewable energy infrastructure: formulation, pricing and impact of a carbon revenue bond. Original Research Article Energy Policy 2012;45:691e770.

[4] E. Martinot and J. Sawin, report Renewables global status report 2009 update, Renewable Energy World Mag. [Online]. Available at:: http://www. renewableenergyworld.com/rea/news/article/2009/09/renewables-globalstatus-report-2009-update

[5] Feili, H. R., Molaee Aghaee, E., Bairampour, M., Akar, N., & Fadaee, A. (2012, May). Development of Solar Drying Systems in Saffron Industry Using FAHP & FQFD. In 3rd International Conference on Nuclear & Renewable Energy Resources, Turkey (pp. 20-23).

[6] A. McCrone, E. Usher, V. Sonntag-O'Brien, U. Moslener and C. Gruning, reportGlobal trends in renewable energy investment 2012, Global trends report. [Online]. Available at:: http://fs-unep-centre.org/publications

[7] 100 per cent renewables study e modelling assumptions and input. AEMO; 2012 [Online]. Available at: http://www.climatechange.gov.au.

[8] Helen C. Launch of emissions trading scheme. New Zealand Government; 2007 [Online]. Available at: http://www.beehive.govt.nz/node/30691.

[9] Martinot E. Renewables global futures report 2013. REN21; 2012 [Online]. Available at: http://www.ren21.net/gfr.

[10] Global renewable energy market outlook with a specific focus on China e June 2012. Bloomberg New Energy Finance; 2012 [Online]. Available at: http:// www.sinocleantech.com/.

[11] Akar, Navid, Elaheh Daj, and Shahrooz Sharifi Boroojerdi. "Using Fuzzy Quality Function Deployment in Improving Reliabality of Wind Power Systems." (2016).

[12] Sawin JL. Renewables 2012: global status report [Online]. Available at: REN21; 2012 http://www.ren21.net/.

[13] Tang M. China renewable energy and the impact of governmental 5-yearsplan for foreign investors. Chinese Renewable Energy Industries Association (CREIA); 2012 [Online]. Available at: http://www.cleantechday.ch.

[14] Singh R, Sood YR. Transmission tariff for restructured Indian power sector with special consideration to promotion of renewable energy sources. Tencon; 2009:1e7.

[15] National renewable energy action plans. European Commission; 2010.

[16] Norway sets ambitious renewables target. Energy Resources; 2012.

[17] Ukraine committed to receive 11% of renewable energy by 2020. European Commission; 2012.

[18] Globserver Global Economics Albania energy profile 2012 [Online]. Available at:, http://globserver.cn/en/albania/energy; 2012.

[19] Fejzibegovia S. Energy efficiency and renewable energy Bosnia & Herzegovina e National study's summary, Mediterranean and National strategies for sustainable development priority field of action 2: energy and climate change; 2007.

[20] Feili, H. R., Akar, N., Lotfizadeh, H., Bairampour, M., & Nasiri, S. (2013). Risk analysis of geothermal power plants using Failure Modes and Effects Analysis (FMEA) technique. Energy Conversion and Management, 72, 69-76.

[21] Kovacevic DSI. Renewable Energy sources in Montenegro, investing in energy efficiency and renewable energy in the Energy Community Conference; 2010.

[22] Kammen DM, Mozafari M, Prull D. Sustainable Energy options for Kosovo-an analysis of resource availability and cost. Renewable & Appropriate Energy Laboratory Energy & Resources Group; 2012.

[23] Implications of The UK Meeting Its 2020 Renewable Energy Target. Poyry Energy (Oxford) Ltd; 2008 [Online]. Available at: http://www.mng.org.uk.

[24] Renewable energy in the 50 states. ACORE; 2012 [Online]. Available at: http:// www.acore.org.