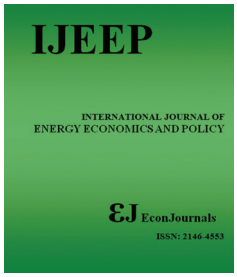

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Economic Growth Model and Renewable Energy Utilization: Perspective of Natural Resources Management and Sustainable Development of the Gowa Regency Region South Sulawesi, Indonesia

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ABSTRACT

Regional development coupled with economic growth requires support for the use of renewable energy to support sustainable management of natural resources and the environment. Furthermore, economic growth towards industrialization has an impact on increasing energy consumption. This study aims to analyze: (1) Economic growth work as a determinant of the use of renewable energy in supporting regional development; (2) The direct and indirect effects of economic growth, the effectiveness of natural resource utilization, and the use of renewable energy on improving the quality of the environment and the sustainability of regional development; (3) Formulating an economic growth model based on the use of renewable energy, natural resource management and sustainable regional development. This study uses a qualitative and quantitative approach sequentially. Data obtained through observation, in-depth interviews, surveys, and documentation. The results showed that economic growth followed by the use, of new and renewable energy had an impact on increasing the productivity of economic enterprises and a positive contribution to improving the quality of the environment. Gowa Regency's future development orientation is oriented towards optimizing the regional economic base sectors, increasing the contribution of the strategic economic sector, effective use of natural resources, strengthening human resource capacity, ensuring the availability and distribution of energy services, increasing regional revenues, and optimizing sources of income new. Furthermore, future economic growth is oriented towards increasing people's incomes, opening new jobs, equitable development, and improving people's welfare. This study recommends that the use of renewable energy is an important aspect that needs to be considered in the formulation of development policies towards economic growth, natural resource management and sustainable regional development of the Gowa Regency South Sulawesi, Indonesia.

Keywords: Economic Growth, Renewable Energy, Environmental Quality, Regional Productivity, Sustainable Development
JEL Classification: Q5

1. INTRODUCTION

Economic growth is the change in economic conditions that occur in a country on an ongoing basis towards a better condition based on gross regional domestic product (GRDP). GDP is calculated from a country's national accounts which report annual data on incomes, expenditure, and investment for each sector of the economy (Arroyo and Miguel, 2020; United Nation, 2003).

Factors, of production, natural resources, and population play an important role in development and their impact on a country's economic growth (Hussain and Haque, 2016). Thus, economic growth is the ability of a region to produce goods and services through innovative processes, products and services, and the use of technology towards sustainable development. That is, the challenges of transitioning from a linear to a circular economy model require the development and application of new knowledge, leading to innovative, technological, and sustainable processes, products, and services (Segura et al., 2020; Surya et al., 2021). Development policies that are oriented towards regional economic growth supported by the use, of technology will accelerate and encourage increased productivity in economic enterprises developed in the community (Surya et al., 2021).

The Asian Development Bank recently released its Asian Development Outlook 2020 and in light, of the COVID-19 outbreak, it is forecasting 2.2% growth for Developing Asia, and 1.0% growth for Southeast Asia, supported by the Chinese economy (ADB, 2020). When compared to the forecast made for December 2019, this lower estimate provides an indication of the extent of the impact of the outbreak. Assuming that the pandemic can be contained this year and does not have a serious ripple effect on the financial system, the recovery can take place in 2021 and Developing Asia can grow 6.2%. Economic growth in Southeast Asia, especially Indonesia, Malaysia, and the Philippines experienced a contraction of 4.4%. Furthermore, for countries in East Asia, namely China, it experienced a decline of 1.8%. Until the end of 2021 ADB estimates China's GDP will grow by 7.7%, India by 8%. Economic activity in the Pacific subregion in 2020 also contracted by 0.3% and is predicted to recover and will grow by 2.7% in 2021 (Asean Policy Brief, 2020). Furthermore, the Indonesian economy is predicted to recover and will grow by 5% in 2021. It is indicated that the economic recovery in 2021 in Asia will have an impact on increasing demand for the use of fossil energy, whose reserves are currently decreasing and its impact on living environmental conditions. Thus, a policy of utilizing new and renewable energy is needed to support economic growth towards sustainable development. The sustainability of the global economy is of paramount importance and sustainable development (SDGs) is a significant step towards harnessing new and renewable energy (Surya et al., 2021).

Gowa Regency is designated as the center of economic growth and a national strategic area in South Sulawesi Province, Indonesia. Economic activity sectors that have a positive contribution to regional gross domestic product of Gowa Regency include: (1) Agriculture, fishery and forestry activities with a contribution value of 5,149,927.65; (2) The wholesale, retail, motorbike and motorcycle repair shops sector with a contribution value of 564,506.88; (3) the construction services sector, the contribution value of 912,613.36; (4) The information and communication sector with a contribution value of 228,864.20; (5) Government administration activity sector with a contribution value of 594,326.55; (6) Education service activity sector with a contribution value of 278,565.62; (7) The manufacturing sector with a contribution value of 3,722,400.36, (8) The mining and quarrying activity sector with a contribution value of 1,172,715.30; (9) The financial services and insurance sector with a contribution value of 234,130.69; (10) Real estate sector with a contribution value of 239,583.40; and (4) Health service activity sector with a contribution value of 111,472.12 (BPS Gowa Regency, 2020).

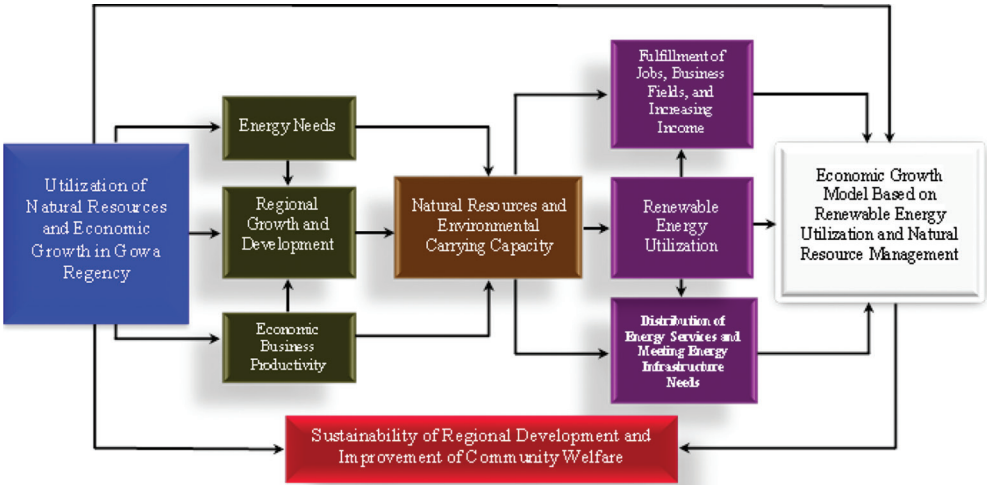
The contribution of the developing economic activity sector in Gowa Regency emphasizes that the acceleration of regional development towards economic growth requires the support of the use of renewable energy and sustainable natural resource management. Public policies that are oriented towards natural resources and energy saving, followed by optimization of industrial management will encourage an increase in regional income and an increase in environmental quality (Giampietro, 2019; Surya et al., 2020). Furthermore, economic growth coupled with the use of new and renewable energy will have an impact on the productivity of economic enterprises, increasing regional income, meeting energy needs, opening new jobs and improving the quality of the environment. The concept of sustainable development is oriented to meeting the needs of the present generation without sacrificing the ability of future generations (United Nation, 1987), meaning that economic growth, social inclusion, and environmental protection are the three main pillars of sustainable development (Wichaisri and Sopadang, 2017). The results of this study contribute to the formulation of development policies through decision making from the government, with the argument being built, namely that increasing economic growth through, the use of renewable energy followed by the effectiveness of natural resource management will encourage development stability towards sustainable regional development. Utilization of renewable energy in Gowa Regency has a strategic and urgency to develop in relation to the use of natural resources in order, to promote sustainable regional economic growth. Thus, the focus of this study is aimed at answering research questions: (1) How do economic growth work as a determinant of the use of renewable energy in supporting regional development? and (2) How are the direct and indirect effects of economic growth, the effectiveness of natural resource utilization, and the use of renewable energy on improving the quality of the environment and the sustainability of regional development? (3) What is the economic growth model based on the use of renewable energy, natural resource management, and sustainable regional development? The conceptual framework of this study is presented in Figure 1 below.

2. MATERIAL AND METHOD

2.1. Research Design

This research is naturalistic and phenomenological by using a combination of quantitative-qualitative approaches sequentially (Creswell, 2016; Sugiono, 2016). Furthermore, the case studies in this study were selected with the following considerations: (1) The economic growth of the Gowa Regency area is quite prominent in the regional context in South Sulawesi; (2) The pattern of economic activity in the Gowa Regency area is quite potential to support the use of renewable energy; (3) The characteristics of the Gowa Regency area are very potential in supporting the increase in the productivity of economic enterprises and the welfare of the community. The qualitative approach in this study is used to

Figure 1: Conceptual framework for economic growth and utilization of renewable energy



Source: Author's elaboration

study and analyze economic growth as a determinant of renewable energy use in supporting regional development. Furthermore, a quantitative approach is used to study and analyze the direct and indirect effects of economic growth, the effectiveness of natural resource utilization, and the use of renewable energy on improving the quality of the environment and the sustainability of regional development. Philosophical reasoning combines the two approaches: (1) The logic of triangulation; In this case the results of qualitative research are checked again on quantitative studies and vice versa, the aim is to strengthen the validity of the findings, (2) quantitative and qualitative research are combined to provide a general picture, (3) a quantitative approach is used in analyzing the relationship between changes, the approach qualitative is used to help align the factors that underlie the relationship being built, and (4) to obtain data from two different realities, it is necessary to combine the two approaches (quantitative and qualitative). The qualitative-quantitative approach schema is sequentially presented in Figure 2 below.

2.2. Study Area

This research was conducted in 18 sub-districts in Gowa Regency, South Sulawesi, which are geographically located at positions 5°5'–5°34.7' South Latitude (LS) and 12°3319'–13°1517" East Longitude (EL). Furthermore, the Gowa Regency area mostly highland areas or 72.26% covering nine districts namely Parangloe, Manuju, Tinggimoncong, Tombolo Pao, Parigi, Bungaya, Bontolempangan, Tompobulu and Biringbulu. The remaining 27.74% are lowland areas covering nine districts, namely Somba Opu, Bontomarannu, Pattallassang, Pallangga, Barombong, Bajeng, West Bajeng, Bontonompo, and South Bontonompo. The dominant economic potentials developed in the Gowa Regency area include: (1) Agriculture and forestry occupy an area of 164,599.07 hectares, (2) industrial activities occupy an area of 44.79 hectares, (3) trade and services occupy an area of 20.79 hectares, (4) Mining occupies an area of 52 hectares. Furthermore, the population of Gowa Regency in 2015 was 722,702 people and in 2020 as many as 765,766 people (BPS Gowa Regency, 2020). The sectors of economic activity developing in Gowa Regency are presented in Table 1 below.

Table 1 shows the economic growth of Gowa Regency. Three interpretations that can be explained in relation to the data include: (1) The sector of economic activity with the highest contribution value, namely the agriculture, forestry, and fisheries sector; (2) the economic activity sector with the lowest contribution, namely the company services sector and (3) the sector with the highest average growth, namely the information and communication sector. This data confirms that the strategic economic activity sector that has been developed has a positive contribution to economic growth and regional revenue revenue for Gawa Regency. Furthermore, the population of Gowa Regency by district for the period 2018–2020 is presented in Table 2 below.

Table 2 shows the potential population in the Gowa Regency area. Three things can be explained related to the data, namely (i) the highest population is located, in the Somba Opu District area and the lowest population is located, in the Parigi District area; (2) Population growth during the 2015–2020 period experienced an increase of 43,074 people with an average growth of 1.56%; (3) The occupational orientation of the dominant population is in the agricultural sector with a population density of 7595 people. Furthermore, the dominant sectors in employment in Gowa Regency are presented in Table 3 below.

Table 3 shows the labor absorption based on the dominant business fields in Gowa Regency. Three things can be explained related to the data, among others: (1) The agricultural sector is the dominant economic activity and absorbs labor or 28.51%, (2) the developing industrial sector consists of two categories, namely medium industry, and small industry with a workforce absorption of 14.82%, and (3) the dominant trade and service sector develops in growth centers and urban areas with a workforce absorption of 15.75%. This figure confirms that the agricultural, industrial, trade and service sectors are the leading sectors in Gowa Regency. The research location is presented in Figure 3 below.

2.3. Method of Collecting Data

Data collection in this study is divided into two categories namely primary data and secondary data. Primary data obtained through

Figure 2: Qualitative-quantitative approach sequentially

Source: Author's elaboration

Table 1: Sector of economic activity in Gowa Regency based on Gross Regional Domestic Product (GRDP) in 2018–2020

Business Field	Gross Regional Domestic Product (GRDP/Year)			
	2018	2019	2020	Average Growth (%)
Agriculture, Forestry, and Fisheries	3,711.46	3,751.39	3,852.28	1.88
Mining and Excavation	427.99	495.07	500.62	8.40
Processing Industry	811.12	911.42	853.49	3.00
Procurement of Electricity and Gas	24.32	25.33	26.55	4.48
Water Supply, Waste Management, and Waste and Recycling	17.27	18.13	19.74	6.93
Construction	1,390.95	1,530.24	1,536.08	5.20
Wholesale, Retail, and Repair of Cars and Motorcycles	1,585.64	1,732.69	1,695.56	3.57
Transportation and Warehousing	181.64	203.96	193.51	3.58
Provision of Accommodation, Food, and Drink	329.24	354.21	316.99	−1.46
Information and Communication	1,423.44	1,581.12	1,752.99	10.97
Financial Services and Insurance	289.66	296.63	308.69	3.24
Real Estate	963.12	1,024.45	1,070.84	5.45
Company Services	15.46	17.06	15.22	−0.22
Government Administration	632.19	741.13	738.99	8.47
Education Services	594.12	634.29	673.34	6.46
Health Services	237.65	257.15	283.84	9.29
Other Services	190.54	208.84	187.04	−0.42

Source: BPS Gowa Regency, 2020

observation, in-depth interviews, and surveys. Meanwhile, secondary data, namely documentation obtained through related agencies. Furthermore, the types of data in the study were divided into two categories namely qualitative data and quantitative data. (1) Qualitative data are obtained through observation, in-depth interviews, and documentation. This data is used by researchers to provide an overview of economic growth in relation to the use of renewable energy in supporting the development of the Gowa Regency area. The data that has been collected is then presented in the form of descriptions, descriptive qualitative, and

categorization. (2) Quantitative data is obtained through a survey using a questionnaire instrument. The data is used to describe economic growth, regional economic base sector, utilization of natural resources, utilization of renewable energy, environmental quality, life, and factors that affect the sustainability of regional development in Gowa Regency. The results of the data obtained are presented in tables and diagrams.

2.3.1. Observation

The observations in this study were used to observe the characteristics of the Gowa Regency area, utilization of natural resources, and utilization of renewable energy. Furthermore, the instruments used in observation, among others; field notes, periodicals, cameras, base maps of natural resource locations and area potential, and checklists. The purpose of the observations made in this study is to describe the economic potential of the Gowa Regency area and sectors of strategic economic activity that require support for the use of renewable energy. Thus, the observations in this study are used to trace data, including: (i) Development of potential economic activities, (ii) economic enterprises developed by the private sector and the community, (iii) conditions and characteristics of regional infrastructure, (iv)) functions and the role of government and community institutions, (v) regional typology, and (vi) utilization of renewable energy. The results of observations made by the researcher are then linked to the theory that is the reference in this study.

2.3.2. In-depth interview

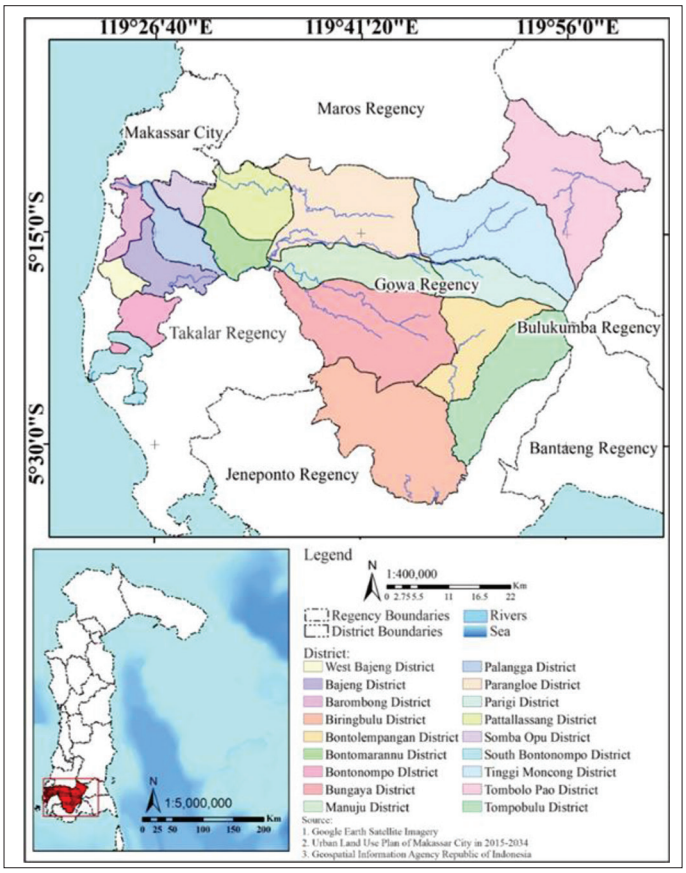
The main subjects of in-depth interviews in this study are local government, industry players and economic entrepreneurs. In-depth interviews were used to deepen the views of the informants regarding the use of renewable energy and economic growth in the Gowa Regency area. The instruments used in in-depth interviews, namely a tape recorder, pictures, and interview guides that are equipped; loose notes and checklists. Furthermore, in-depth interviews in this study were used to explore data, including: (1) The role of the government in the use of renewable energy, (2) the role of industry players in the use of renewable energy, (3) the role and participation of the community in the use of renewable energy, and (4) economic ventures that have the potential to utilize renewable energy. The

Table 2: Total population of Gowa Regency by district during the 2018–2020 period

District	Area (km^2)	Total Population (Person)		Population Density (Person/km^2)	
		2018	2020	2018	2020
Bontonompo	30.39	41,502	44,998	1,365.65	1,480.68
South Bontonompo	29.24	29,626	32,118	1,013.20	1,098.43
Bajeng	60.09	67,883	72,006	1,129.69	1,199.30
West Bajeng	19.04	24,588	26,639	1,291.39	1,399.11
Pallangga	48.24	117,115	127,837	2,427.76	2,650.02
Barombong	20.67	38,734	45,192	1,873.92	2,186.36
Somba Opu	28.09	157,448	156,108	5,605.13	5,557.42
Bonto Marannu	52.63	34,453	41,016	6,54.63	779.33
Pattalassang	84.96	23,752	30,254	2,79.57	356.10
Parangloe	221.26	18,118	18,628	8,1.89	84.19
Manuju	91.9	14,852	14,591	1,61.61	158.77
Tinggimoncong	142.87	23,621	23,332	1,65.33	163.31
Tombolo Pao	251.82	28,850	29,779	1,14.57	118.26
Parigi	132.76	12,797	13,289	9,6.39	100.10
Bungaya	175.53	16,269	16,742	9,2.69	95.38
Bontolempangan	142.46	12,512	14,781	8,7.83	103.76
Tompobulu	132.54	28,748	28,393	2,16.90	214.22
Biringbulu	218.84	31,834	30,073	1,45.47	137.42

Source: BPS Gowa Regency, 2020

Figure 3: Study locations of Gowa Regency South Sulawesi, Indonesia



Source: Author elaboration and Google Map@, 2020

Table 3: Total of population based on employment in Gowa Regency 2020

Business Field	Labor Absorption					
	Man		Women		Total	Percentage (%)
	Total	Percentage (%)	Total	Percentage (%)		
Agriculture	51,600	25.09	48,422	33.37	100,022	28.51
Industry	36,817	17.90	15,161	10.45	51,978	14.82
Trading	42,582	20.70	45,244	31.18	87,826	25.04
Services	24,576	11.95	30,675	21.14	55,251	15.75
Others	50,097	24.36	5610	3.87	55,707	15.88

Source: BPS Gowa Regency, 2020

results of the data obtained through in-depth interviews are used to describe the potential use of renewable energy in supporting the development of the Gowa Regency.

2.3.3. Questionnaire

The questionnaire in this study is used for two functions: (1) Descriptive, namely to describe economic growth and the use of new and renewable energy; and (2) Measurement data from the questionnaire in this study using ordinal and interval scales. This means that the data obtained is tiered and stratified from the lowest to the highest. This means that the questionnaire in this study is used to provide an overview of the characteristics of industry players and economic enterprises as well as the role of government and society in the use of renewable energy in Gowa Regency. The questions posed to respondents are divided into two categories, namely structured and unstructured which have been prepared previously. Furthermore, the use of questionnaires in this study is used in data tracking, including: (a) The socio-cultural conditions of the community, (b) per capita income, (c) employment and business opportunities, (d) the role of community and government institutions, (e) effectiveness of natural resource utilization, (d) energy distribution, (e) renewable energy use, (f) energy availability, (g) energy needs, (h) public and private participation, (i) energy infrastructure services, (j) service coverage energy, and (k) the carrying capacity of the environment.

The results of the data obtained through the questionnaire were then given a scoring value, namely (i) value 5 for the very supportive category, (ii) value 4 for the supportive category, (iii) value 3 for the sufficiently supportive category, (iv) value 2 for the less supportive category, and (v) the value 1 for the category not supportive. The questionnaire was distributed to 18 sub-districts in the Gowa Regency area. The reason the researchers determined the location was based on the consideration that the economic growth of the Gowa Regency region influenced regional development towards the use of renewable energy. Furthermore, the criteria for actors who filled out the questionnaire (respondents), namely (i) local government, (ii) industrial players and economic enterprises, and (iii) communities in each district in relation to renewable energy needs.

2.3.4. Documentation

This study uses various documents related to economic growth, natural resources, and the use of renewable energy. These documents include: (1) Data on the population and economic growth of Gowa Regency, obtained through the Central Bureau of Statistics of Gowa Regency; (2) Profiles of industrial and economic entrepreneurs are obtained through the Mining and Energy Office of Gowa Regency and the Trade and Industry Service; (3) The socio-economic profile of the community is obtained through the District Government; and (4) Gowa Regency Spatial Planning, obtained through the Gowa Regency Spatial Planning Office. The four documents are used to support the results of observation data, in-depth interviews, and the results of the research questionnaire.

2.3.5. Research informants and respondents

The qualitative data in this study is in the form of information related to the use of renewable energy, the source of which is obtained from informants. The informants were determined using the snowball method. This means that the researcher determines community leaders, local government, economic and industrial entrepreneurs who can be interviewed in relation to the use of renewable energy. Furthermore, informants were also identified from several respondents who had been previously interviewed. The consideration is to explore some of the questionnaire results which still require a more detailed explanation. Furthermore, quantitative data in this study were obtained from respondents or research samples using a questionnaire instrument. The research sample in this study was determined using purposive sampling, which the researcher determined based on certain characteristics. Withdrawal of samples was based on Taherdoost (2016). The formulations used in determining the sample are as follows:

$$n = p\ (100-p)z2/E2 \quad (1)$$

Where n is the required sample size, p is the percentage occurrence of state or condition, E is the percentage maximum error required, z is the value corresponding to level convidence required. Z is the statistical value corresponding to the level confidence is needed. The confidence level used was 95% (0.05: Z value equals 1.96) or 99% (0.01: Z = 2.57). The 95% confidence level implies that 95 out of 100 samples will have actual population values within the specified margin of error (E). The number of samples in this study was 450.

2.4. Data Analysis Method

The analytical method used in this study refers to the research question posed, namely How do economic growth work as a determinant of the use of renewable energy in supporting regional development? In order to answer these research questions, the analysis methods used include: (i) Shift-share analysis, (ii) location quotient (LQ) analysis, (iii) analysis of per capita income, and (iv) spatial distribution analysis in relation to fulfillment of energy needs. Using this analytical method, the results are then linked to the use of renewable energy. Shift-share analysis uses the following formulations:

$$D_{ij} = N_{ij} + M_{ij} + C_{ij} \quad (2)$$

$$N_{ij} = E_{ij}\ r_n \quad (3)$$

$$M_{ij} = E_{ij}(r_{in} - r_n) \quad (4)$$

$$C_{ij} = E_{ij}\ (r_{ij} - r_{in}) \quad (5)$$

$$D_{ij} = E_{ij}r_n + E_{ij}\ (r_{in} - r_n) + E_{ij}\ (r_{ij} - r_{in}) \quad (6)$$

$$SN_{ij} = M_{ij} + C_{ij} \quad (7)$$

Where N_{ij} is the change in sectors/subsectors in the Gowa Regency area caused by the influence of economic growth in the South Sulawesi Region, M_{ij} is the change in GRDP sector/subsector i in the Gowa Regency area caused by the influence of sector i growth in South Sulawesi, C_{ij} is the change in sector/sector GRDP/subsector i in the Gowa Regency area caused by the competitive advantage of sector i in the Gowa Regency area, E_{ij} is the GRDP

sector/subsector i in the Gowa Regency area at the beginning of the year, Ein is the GRDP sector/subsector i in the South Sulawesi region, E_n is the total GRDP South Sulawesi at the beginning of the year, E_{ij},t is the GRDP sector/subsector i in the Gowa Regency area, Ein, t is GRDP of sector/sub-sector i of South Sulawesi region, En, and t is total GRDP of South Sulawesi region. If M_{ij} + C_{ij} is >0, then the growth of the i-th sector in the j-region is included in the progressive (advanced) group. If M_{ij} + C_{ij} is <0, then the i-th sector in the j-region is included in the slow growth category. If M_{ij} is smaller than 0, then sector i in Gowa Regency has a slow growth rate. If M_{ij} is >0, sector i is growing rapidly. If C_{ij} is >0, then sector i has high competitiveness compared to other regions. If C_{ij} is <0, then sector i has low competitiveness. If SN_{ij} is >0, the sector under study has a progressive growth. If the SN_{ij} is smaller than 0, the sector under study shows a growth that is not progressive. Furthermore, the location quotient (LQ) analysis uses the following formulation:

$$LQij = \frac{X_{ij} / RV_{ij}}{X_i / RV} \text{ or } LQij = \frac{X_{ij} / X_i}{RVi / RV} \quad (8)$$

$$DLQij = \frac{1 + g_{ij} / 1 + g_j}{1 + G_i / 1 + G} \quad (9)$$

Where LQ_{ij} is the location quotient sector i index/coefficient in Gowa Regency, X_{ij} is the GRDP sector i in Gowa Regency, X_i is the GRDP sector i in the South Sulawesi Province, RV_i is the total GRDP of Gowa Regency, and RV is the total GRDP of South Sulawesi Province. DLQ is the dynamic location quotient index, gij is the average growth rate of the subsector i in Gowa Regency, g_j is the growth rate in Gowa Regency, G_i is the average growth rate of the subsector in South Sulawesi Province, and G is the growth rate at the Provincial level South Sulawesi. Furthermore, the per capita income analysis uses the following formulation:

$$GRDPpk = GRDP \ / \sum p \ x \ 100\% \quad (10)$$

Where GRDP is the final expenditure component for sectors of economic activity, pk is the income received by each resident, and ∑P is the number of residents in, a given location. Furthermore, analysis of spatial distribution in meeting renewable energy needs in support of regional development in Gowa Regency, using analysis methods of nearest neighbors, entropy index, and concentration-deconcentration and distribution index. The analysis used for these three methods used the following formulations:

$$T = Ju / Jh \ (\sum J / \sum N) \quad (11)$$

$$Jh = 1/2\sqrt{P} \ P = (\sum n / L) \quad (12)$$

$$IE = (-\sum Pi \ ln \ Pi) \ / \ ln \ K \quad (13)$$

$$C = \frac{\sum n(Xi - Yi)}{2} \quad (14)$$

$$DQ = (Yi - Xi) \quad (15)$$

$$D = (C2 - C1) \quad (16)$$

$$L = 100 - \frac{\sum n(Xi - Yi)}{2} \quad (17)$$

Where T is the index of the spread of the nearest neighbor, Ju is the average distance measured between one point of the nearest neighbor, Jh is the average distance obtained by a random pattern $1/2\sqrt{P}$, and P is the density of points per km^2, namely the number of points (N) divided by the area in km^2 (A), so that it becomes (N/A). Furthermore, IE is the entropy index, P_i is the percent value of the object, transferred in the form 0 to 1, lnP_i is the natural logarithmic of the value Pi, and lnK is the natural logarithmic of the number of objects (regions). C is the concentration index, X_i, is the percentage area of sub-region i, Y_i is the percentage of total activities contained in sub-region i, n is the number of sub-regions, and DQ is the quotient distribution. Furthermore, D is deconcentration, in this case the deconcentration is done by subtracting the value of C at a time (C2) with the value at the previous time (C1). L is the association, n is the number of sub-regions, X_i, is the percentage of the number of first activities in sub-region i, Yi is the percentage of the number of second activities in sub-region i.

In order, to answer the two questions of this study, namely how are the direct and indirect effects of economic growth, the effectiveness of natural resource utilization, and the use of renewable energy on improving the quality of the environment and the sustainability of regional development, using the path analysis method. The case in this study shows a relationship or correlation between variables (X_1) economic growth, (X_2) natural resource utilization, (X_3) renewable energy (there is a relationship between variables X_1, X_2, and X_3), quality of the environment (Y), and sustainability of regional development (Z). The path analysis model is presented in Figure 3 below.

Figure 4 shows the relationship between the variables X_1, X_2, and X_3. The magnitude of the relationship is expressed by the correlation coefficient (r_{12}), (r_{13}), and (r_{23}). The equation used is as follows:

$$Y = PYX1 + PYX2 + PYX3 + \varepsilon 1 \quad (18)$$

$$X_3 = \rho_{31} X_1 + \rho_{32} X_2 + \varepsilon 1 \quad (19)$$

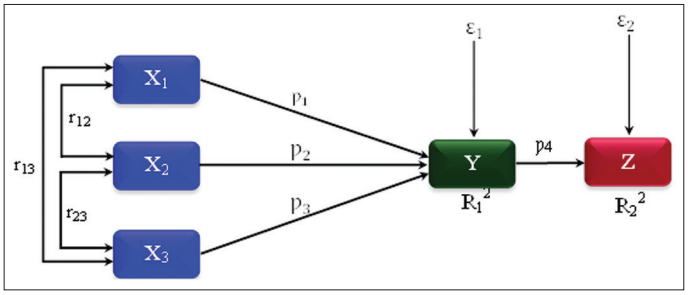
$$Y = \rho Y_1 X_1 + \rho Y_2 X_2 + \rho Y_3 X_3 + \varepsilon 2 \quad (20)$$

$$Z_2 = \rho_{21} + Z_1 + \varepsilon 2 \quad (21)$$

$$Z_3 = \rho_{31} Z_1 + \rho_{32} Z_2 + \varepsilon 3 \quad (22)$$

Path analysis requires a relationship expressed by the correlation coefficient (r_{12}), (r_{13}), and (r_{23}), (r_{12}) is the correlation or relationship between X_1 and X_2, (r_{13}) is the correlation or relationship between X_1 and X_3, (r_{23}) is the relationship or correlation between X_2 and X_3. The variables X_1, X_2, and X_3 act as independent variables that affect the dependent variable (Z) through the intervening variable (Y). That is, X_1, X_2, and X_3, against Z not directly but through intermediary or intervening Y. Thus, X_1, X_2, and X_3 affect Y, then

Figure 4: Model path analysis



Source: Author elaboration

Y affects Z. Three, things can be explained in this regard, namely (i) the independent variable X_1 and the intervening variable Y are connected by the regression coefficient (p_1), (ii) the independent variable X_2 and the intervening variable Y are connected by the regression coefficient (p_2), and (iii) the independent variable X_3 and the intervening variable Y are connected by the regression coefficient (p_3). The direct effect of X_1 on Y is the square of the regression coefficient (p_1^2), the direct effect of X_2 on Y is the squared of the regression coefficient (p_2^2), the direct effect of X_3 on Y is the squared of the regression coefficient (p_3^2). Furthermore, the coefficient of determination (R^2) represents the value of the total effect of the independent variables under study on the dependent variable. R_1^2 is the total effect (both direct and indirect) X_1, X_2, and X_3 on Y, R_2^2 is the total effect of Y on Z.

In order, to answer the third question namely, what is the economic growth model based on the use of renewable energy, natural resource management, and sustainable regional development, using SEM analysis. Data processing through Structural Equation Modeling (SEM) using confirmatory analysis (CFA) method. CFA is a measurement model for observed variables (indicators) reflecting certain latent variables. Seven stages of the formation procedure in SEM analysis, namely: (1) Forming a theoretical model as the basis for the SEM model. That is, this model is causal or causal which states the relationship between variables; (2) Build a path diagram of the causal relationship that has been formed based on the theoretical basis; (3) Divide the path diagram into a set of measurement models and structural models; (4) Selection of input data matrix to estimate the proposed model; (5) Testing the unidimensionality of each construct by confirming factor analysis by estimating the full model equation; (6) Testing and evaluating the assumptions of the structural model; and (7) Interpreting the model.

The application of SEM in this study refers to several variables, including: (1) exogenous independent variable X_1 (sector economy); (2) the independent variable X_2 is exogenous (natural resources); (3) exogenous independent variable (renewable energy) X_3; and (4) exogenous independent variable X_4 (economic productivity); to (5) the endogenous dependent variable Y_1 (economic growth); and (6) endogenous dependent variable Y_2 (sustainability of regional development). Furthermore, latent and endogenous variable construction indicators include various factors, including: (a) Regional productivity latent variables: (1) economic sector activities, measured by indicators, namely the basic economy and the contribution of the economic sector; (2) natural resources, measured by indicators of the effectiveness of utilization and human resources; (3) Renewable energy, measured by indicators, namely energy availability and distribution of energy services; and (4) economic productivity, measured by indicators of regional revenue and sources of income. (b) Endogenous construction variables: (1) Economic growth is measured by indicators of income per capita and job availability; and (2) The sustainability of regional development is measured by indicators of equitable development and community welfare. The SEM analysis method uses the following formulation:

$$1 = Y_{11}\xi_1 + Y_{12} + \xi_1 \quad (23)$$

$$\eta_2 = \beta_{21}\eta_1 + \xi_2 \quad (24)$$

$$\eta_3 = \beta_{31} + Y_{32} + \xi_2 + \xi_3 \quad (25)$$

$$\eta = \beta_n + \Gamma\xi\xi + \xi \quad (26)$$

Where β_{21}, β_{31}, βn is the regression coefficient, ξ_1, ξ_2 ξ_3 is the exogenous variable and η_1 is the endogenous variable, X_1, X_2, and X_3 are the observed variables, which function as indicators of latent variables ξ_1 and Y_{11}, Y_{12} function as indicators of latent variables η_1 and η_2 residual error (residual term), which is ζ_1 which is related to the prediction of the latent variable value η_1, the measurement error (error term) for Y_{11}, Y_{12}, and Y_{32} namely ε_1 and ε_2 and the measurements for X_1, X_2, X_3, and X_4 namely $_1$, $_2$, and $_3$. Furthermore, the arrow in the direction of ξ_1 to η_1 indicates that the exogenous latent variable ξ_1 affects the endogenous latent variable η_1. The arrows in the direction of ξ_1 to X_1, X_2 X_3 X_4 and from η_1 to Y_{11} and Y_{12} are represented by λ. The regression path, which shows the influence of each latent variable on each of the indicators. The two-way arrow between X_1 and X_2 is the covariance/correlation between the indicators X_1 and X_2. Furthermore, structural equation modeling (SEM) is presented in Figure 5 below.

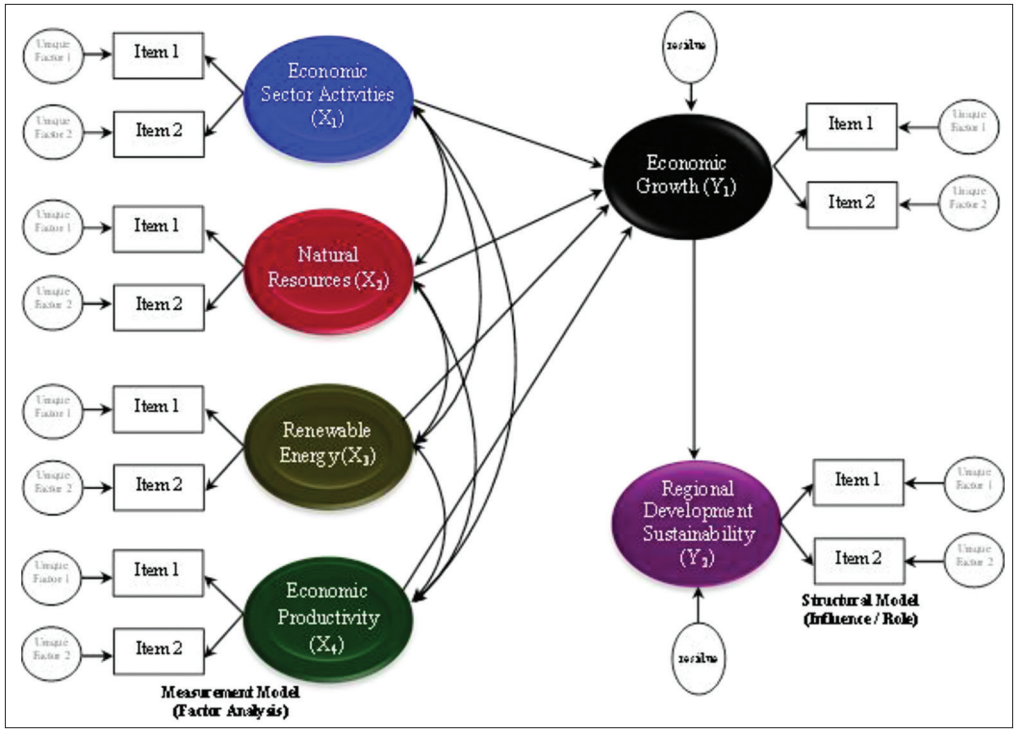
The use of SEM in this study aims to build a model of economic growth, utilization of renewable energy, natural resource management and sustainable regional development. The results of the SEM analysis will describe two things: (1) A combination of measurement models (factor analysis) and structural models; and (2) the role of items in measuring the construct and the role of constructs in other constructs. The assumptions built in SEM are: (1) that each indicator has a value that is normally distributed to each other; (2) that each variable is latently dependent on a model that is normally distributed on the value of each of the other latent variables; (3) that there is a linear relationship between the indicator variable and the latent variable, as well as between the latent variable itself; and (4) that the typical indirect measure, in this case all variables in the model, is the latent variable.

3. RESULT AND DISCUSSION

3.1. Determinants of Economic Growth and Renewable Energy Utilization

The economic growth of Gowa Regency based on gross regional domestic product (GDRP) in 2018 reached a figure of

Figure 5: Application of structural equation modeling (SEM)



Source: Author elaboration

19,063 billion or 4.12% of the GRDP of South Sulawesi province. Furthermore, in 2019 the GDRP contribution of Gowa Regency to South Sulawesi has increased by a figure of 24,265 billion or 2.48%, and in 2020 with the contribution value of Gowa Regency PDRB to South Sulawesi reached a figure of 14,025.76 billion or 4.27%. These results indicate that the strategic economic activity sector in Gowa Regency has, a tendency to continue to increase and affect the economic growth of the South Sulawesi region. The trade and services sector contributes to modern economic growth and industrialization is an engine of economic growth (Surya, 2014; Gryshova et al., 2020; Jiang, 2020). Furthermore, economic growth which tends to increase, and excessive energy use will have an impact on increasing pollution and decreasing environmental quality (Bilan, 2020). In general, the achievement of the economic growth target of Gowa Regency is illustrated by the nominal amount of public savings in regional development banks. In 2016, it was recorded at 1602 trillion, then increased in 2020 by 1794 trillion. This figure confirms that the economic growth of Gowa Regency, apart from absorbing workers, also has an impact on improving the welfare of the community. Equitable income distribution in the economy is a driving factor for increased productivity of labor and business activities, and its impact on regional growth (Setyowati, 2020). The contribution of sectors of economic activity in Gowa Regency is presented in Table 4 below.

Table 4 shows the economic growth of Gowa Regency which is influenced by several business fields, including: (i) Agriculture, forestry, and fisheries with a contribution value of 474,767.45 or 19.44%, (ii) wholesale trade, retail, and car and motorcycle repair shops with contribution value of 387,878.19 or 15.88%, (iii) construction services with a contribution value of 297,884.13 or 12.19%, (iv) information and communication with a contribution value of 359,145.35 or 14.70%, and (v) the real estate sector with a contribution value of 186,519.61 or 7.63%. This figure confirms that the growth of economic activity sectors in Gowa Regency will require support for the use of renewable energy to support regional productivity. Thus, the use of renewable energy sources to support economic growth will have an impact on meeting energy needs, energy security, energy access, and mitigating climate change (Surya, 2015; Maksum et al., 2020). Furthermore, the basic economic sectors in Gowa Regency are presented in Table 5 below.

Table 5 shows the basic economic sector and dynamic location quotient index in Gowa Regency. Interpretations that can be proposed for these results include: (1) Base sectors that have prospective development, namely water supply, waste management, waste and recycling; (2) The basic sectors are not prospective, namely agriculture, forestry, and fisheries, procurement of electricity and gas, provision of accommodation, food and drink, information and communication, real estate, government administration and other services; (3) Non-base sectors that have prospective development, namely mining and excavation, transportation and warehousing; and (4) business fields which are non-basic, non-prospective sectors, namely processing industry, construction, wholesale, retail, and repair of cars and motorcycles, financial services and insurance, company services, education services, and health services. Thus, policy stimulation is needed to boost the domestic economy and basic economic sectors to support regional development (Fu et al., 2020; Stankeviciute and Savanevi˘ciene, 2018). Furthermore, the specialization index of economic activity sectors in Gowa Regency is presented in Table 6 below.

Table 6 shows that the absolute total X-Y is as many as 36 sectors of economic activity. Thus, the specialization index (SI) in Gowa

Table 4: Economic growth in Gowa Regency based on business fields

Business field	Gowa Regency Economic Growth (Rupiah)			
	Growth Component	Proportional Growth	Economic Competitiveness	Income Change
Agriculture, Forestry, and Fisheries	5,149,927.65	−4505875.65	(797,543.17)	474,767.45
Mining and Excavation	469,929.10	−451721.96	(23,729.13)	132,931.15
Processing Industry	1,057,214.59	−959347.72	(148,222.96)	147,315.02
Procurement of Electricity and Gas	30,124.84	−25035.76	(711.51)	5,409.30
Water Supply, Waste Management, and Waste and Recycling	22,418.72	−19439.00	(2,173.09)	3,189.52
Construction	1,740,864.35	10985523.65	12,376,471.31	297,884.13
Wholesale, Retail, and Repair of Cars and Motorcycles	1,907,618.73	−1488525.90	97,118.48	387,878.19
Transportation and Warehousing	240,986.62	−197372.49	(15,749.68)	30,310.80
Provision of Accommodation, Food, and Drink	394,579.90	−303276.83	25,961.17	81,486.99
Information and Communication	1,695,051.80	−1334966.60	88,477.24	359,145.35
Financial Services and Insurance	382,623.73	−324595.21	(34,937.44)	49,413.87
Real Estate	1,236,845.27	−1110318.98	(147,202.13)	186,519.61
Company Services	19,401.52	−15904.67	(441.53)	3,281.21
Government Administration	908,470.57	−820503.98	(188,311.55)	61,776.91
Education Services	746,857.49	−612284.25	(18,162.81)	125,180.43
Health Services	304,932.07	−251063.26	(13,410.13)	46,190.70
Other Services	225,398.89	−174270.82	16,266.28	49,012.40

Source: Analysis results

Table 5: Basic economic sector and dynamic location quotient index

Business Field	Growth (%)	Location Quotient (LQ) Value	Indeks Dynamic Location Quotient (DLQ)	Information
Agriculture, Forestry, and Fisheries	2.70	1.36	0.44	The base sector is not prospective
Mining and Excavation	9.81	0.68	36.17	Prospective non basis sector
Processing Industry	3.21	0.47	0.53	Non-base sector, not prospective
Procurement of Electricity and Gas	2.10	1.95	0.06	The base sector is not prospective
Water Supply, Waste Management, and Waste and Recycling	7.76	1.17	5.73	Prospective basis sector
Construction	6.30	0.86	0.36	Non-base sector, not prospective
Wholesale, Retail, and Repair of Cars and Motorcycles	5.64	0.80	0.28	Non-base sector, not prospective
Transportation and Warehousing	5.27	0.48	1.60	Prospective non basis sector
Provision of Accommodation, Food, and Drink	2.56	1.71	0.04	The base sector is not prospective
Information and Communication	10.42	1.59	0.52	The base sector is not prospective
Financial Services and Insurance	3.37	0.63	0.43	Non-base sector, not prospective
Real Estate	5.52	2.14	0.99	The base sector is not prospective
Company Services	2.51	0.26	0.03	Non-base sector, not prospective
Government Administration	6.85	1.20	0.37	The base sector is not prospective
Education Services	7.49	0.81	0.58	Non-base sector, not prospective
Health Services	8.70	0.90	0.95	Non-base sector, not prospective
Other Services	3.59	1.04	0.06	The base sector is not prospective

Source: Analysis results.

Regency is 36/2 = 18 or 0.18 and tends to be close to 0. The specialization index value shows a tendency to increase and is evenly distributed. Sectors that have a positive contribution to economic growth in Gowa Regency, namely agriculture, forestry, and fisheries, procurement of electricity and gas, water supply, waste management, and waste and recycling, provision of accommodation, food, and drink, provision of accommodation, food, and drink, information and communication, real estate, government administration, and other services with a value of 38.88%. The specialization of economic activities in Gowa Regency is closely related to increasing per capita income of the population and optimizing the use of natural resources. Excessive dependence on natural resources will have an impact on the balance of the environment and the productivity of economic enterprises (Stofkova and Sukalova, 2020; Surya et al., 2015). Thus, optimizing the use of natural resources is very important to integrate with the strengthening of human resource capacity through government policy support towards the use of renewable energy and sustainable regional development. Thus, optimizing the use of natural resources through the support of sustainable human resource management (HRM) is oriented towards several principles, namely concern for the environment, profitability, labor participation, external partnerships, flexibility, cooperation, fairness, and equality (Caruso et al., 2020; Martins, 2020; Hernita et al., 2021). Per capita income of the population by district area in Gowa Regency is presented in Table 7 below.

Table 7 shows the level of per capita income of the population in Gowa Regency, which is divided into three categories, namely (1) high income economic; (2) upper-midle economic income;

Table 6: Specialization index of the economic activity sector in Gowa Regency

Business Field	Gowa Regency		South Sulawesi Province		X-Y	X-Y (Absolut)
	(Rupiah)	X (%)	(Rupiah)	X (%)		
Agriculture, Forestry, and Fisheries	3852.28	27.47	66064.12	20.13	7.34	7.34
Mining and Excavation	500.62	3.57	17274.28	5.26	−1.69	1.69
Processing Industry	853.49	6.09	42850.48	13.06	−6.97	6.97
Procurement of Electricity and Gas	26.55	0.19	318.67	0.10	0.09	0.09
Water Supply, Waste Management, and Waste and Recycling	19.74	0.14	394.15	0.12	0.02	0.02
Construction	1536.08	10.95	41875.48	12.76	−1.81	1.81
Wholesale, Retail, and Repair of Cars and Motorcycles	1695.56	12.09	49799.33	15.17	−3.08	3.08
Transportation and Warehousing	193.51	1.38	9424.21	2.87	−1.49	1.49
Provision of Accommodation, Food, and Drink	316.99	2.26	4325.23	1.32	0.94	0.94
Information and Communication	1752.99	12.50	25869.89	7.88	4.62	4.62
Financial Services and Insurance	308.69	2.20	11457.26	3.49	−1.29	1.29
Real Estate	1070.84	7.63	11703.74	3.57	4.07	4.07
Company Services	15.22	0.11	1355.8	0.41	−0.30	0.30
Government Administration	738.99	5.27	14416.91	4.39	0.88	0.88
Education Services	673.34	4.80	19465.08	5.93	−1.13	1.13
Health Services	283.84	2.02	7382.8	2.25	−0.23	0.23
Other Services	187.04	1.33	4215.38	1.28	0.05	0.05

Source: Analysis results

Table 7: Per capita income of the population in Gowa Regency

District Area	Total Population (Person)	Income Per Capita	Information
Bontonompo	44,998	107,625,731	Upper-Midle Income Economic
South Bontonompo	32,118	76,819,486	Upper-Midle Income Economic
Bajeng	72,006	172,223,173	High Income Economic
West Bajeng	26,639	63,714,873	Upper-Midle Income Economic
Pallangga	127,837	305,759,156	High Income Economic
Barombong	45,192	108,089,738	Upper-Midle Income Economic
Somba Opu	156,108	373,377,429	High Income Economic
Bonto Marannu	41,016	98,101,626	Upper-Midle Income Economic
Pattalassang	30,254	72,361,191	Upper-Midle Income Economic
Parangloe	18,628	44,554,249	Lower-Midle Income Economic
Manuju	14,591	34,898,596	Lower-Midle Income Economic
Tinggimoncong	23,332	55,805,226	Upper-Midle Income Economic
Tombolo Pao	29,779	71,225,091	Upper-Midle Income Economic
Parigi	13,289	31,784,487	Lower-Midle Income Economic
Bungaya	16,742	40,043,335	Lower-Midle Income Economic
Bontolempangan	14,781	35,353,036	Lower-Midle Income Economic
Tompobulu	28,393	67,910,071	Upper-Midle Income Economic
Biringbulu	30,073	71,928,277	Upper-Midle Income Economic

Source: Analysis results

and (3) lower-midle income economies. The level of income per capita of the population with the highest category is located, in the Somba Opu District area. Furthermore, the lowest per capita income is located, in the Parigi District area. The difference in the income level of the population confirms that the ability of the community to meet energy needs varies widely and is highly dependent on the orientation of work and economic enterprises being developed. The consumption of renewable energy has an influence on social conditions, public health, the efficiency of economic enterprises, and an increase in people's income (Schoden et al., 2020; Rao and Yan, 2020; Syafri et al., 2020). The potential for renewable energy that can be utilized to support economic growth and regional development in Gowa Regency, among others: First, the Jeneberang watershed, which is the largest river in South Sulawesi with a water catchment area of 881 km^2 with a river length of 90 Km. The Jeneberang River is currently being utilized through support for the construction of the Bili-Bili Dam with a service area of 2415 km^2. The Jenneberang watershed has currently been used to meet needs, including: (1) Irrigation water needs for wetland farming covering an area of 24,600 hectares, (ii) distribution of clean water services for the people of Gowa Regency and Makassar City with a total production of 35,000,000 m^3, and (iii) a hydroelectric power plant with a magnitude of 16.30 Mega Watt. The socio-economic development of an area is intrinsically related to energy consumption towards the use of renewable energy (Jiang et al., 2018).

Second, the Karalloe Dam, which is located, in the Tompobulu District area, with a capacity of 40.53 million m^3 with an inundation area of 145 hectares. The dam is used for several purposes, namely (i) meeting the needs for agricultural irrigation covering an area of 7004 hectares, (ii) utilizing raw water sources with a capacity of 440 l/s, (iii) flood control with a capacity of 2020 m^3/s, and (iv) generating electric power of 4.5 MW. Third, the water resources of Lake Mawang with an area of 50 hectares and stretching 1.4 km along with a width of 200–450 m. Lake Mawang is currently not used as an energy source and is only

used for the development of regional tourism potential. Fourth, a mini-hydro power plant, located in the Tombolo Pao District area, which is capable, of producing electricity with a capacity of 3.0 Mega Watt. Fifth, wind energy with a speed of 2–4 m/s has the potential for small-scale electricity generation to support the development of rural areas. The use of wind energy via turbines for small-scale electrical services requires recycling which has expired (Surya et al., 2018; Mayer et al., 2016).

Sixth, bioenergy obtained through the development of bioenergy-producing crops, namely (i) biodiesel covering an area of 601,992 hectares, (ii) bioethanol covering an area of 40,700 hectares, (iii) biogas originating from livestock manure as many as 1,190,708 heads scattered in nine sub-districts, and (iv) biobriquette with a total production of 1,000,966 tons, which spreads over 12 sub-districts. Furthermore, the construction of a biomass power plant with fuel converted from biological and organic materials, in this case sourced from corn cobs is located, in Biring Bulu District with a production capacity of 2 × 20 kW using a gasification system. Thus, the potential for renewable energy is very important to optimize its use in Gowa Regency towards economic growth, reducing gas emissions, and improving environmental quality in a sustainable manner. This means that the economy will develop rapidly if environmental security is guaranteed (Lin et al., 2019; Surya et al., 2020).

3.2. Spatial Distribution and Effectiveness of Natural Resources Utilization

Population activities related to the use of natural resources are closely related to the characteristics and geographical conditions of the area. This means that geographical factors play an important role in the allocation of various socio-economic activities. Spatially, the allocation of land use in relation to socio-economic activities refers to the carrying capacity of the environment and population distribution for each sub-district. That is, the allocation of socio-economic activities is based on physical location considerations and based on the distance of service coverage from the location of residential areas. Four important factors are influencing, namely population density, road density, built-up area, and green coverage ratio of the spatial distribution (Surya, 2015; Bao et al., 2020). Furthermore, the spatial distribution pattern of socio-economic activities in Gowa Regency in relation to meeting energy needs is presented in Table 8 below.

Table 8: The distribution pattern of socio-economic activities in Gowa Regency

District Area	Area/ km² (A)	Socio-Economic Activities (N)	Inner Point Density km² (p)	Average distance between points (Ju)	Average distance of random pattern points (Jh)	Nearest Neighboring Spread Index (T)	Information
Bontonompo	30.39	499	16.42	0.97	2.03	0.48	Cluster Pattern
South Bontonompo	29.24	485	16.59	1.85	2.04	0.91	Random Pattern
Bajeng	60.09	638	10.62	1.67	1.63	1.03	Random Pattern
West Bajeng	19.04	71	3.73	1.29	0.97	1.34	Random Pattern
Pallangga	48.24	958	19.86	1.48	2.23	0.66	Cluster Pattern
Barombong	20.67	302	14.61	1.97	1.91	1.03	Random Pattern
Somba Opu	28.09	3429	122.07	3.26	5.52	0.59	Cluster Pattern
Bonto Marannu	52.63	580	11.02	2.98	1.66	1.79	Dispered Pattern
Pattalassang	84.96	328	3.86	1.17	0.98	1.19	Random Pattern
Parangloe	221.26	479	2.16	0.78	0.74	1.06	Random Pattern
Manuju	91.9	83	0.90	0.59	0.48	1.24	Random Pattern
Tinggimoncong	142.87	389	2.72	0.65	0.83	0.78	Random Pattern
Tombolo Pao	251.82	346	1.37	0.66	0.59	1.13	Random Pattern
Parigi	132.76	251	1.89	0.58	0.69	0.84	Random Pattern
Bungaya	175.53	378	2.15	0.64	0.73	0.87	Random Pattern
Bontolempangan	142.46	328	2.30	0.68	0.76	0.89	Random Pattern
Tompobulu	132.54	275	2.07	0.70	0.72	0.97	Random Pattern
Biringbulu	218.84	427	1.95	0.67	0.70	0.96	Random Pattern

Source: Analysis results

Table 8 shows the spatial distribution and distribution of socio-economic activities in the Gowa Regency area. Interpretations that can be proposed regarding these results include: (1) Cluster Pattern of 16.66% with the highest index value of the distribution of the closest neighbors and forming a clutser pattern located in Palangga District with a value of 0.66; (2) The dominant random pattern is 77.77% with the highest distribution index value of the closest neighbors in West Bajeng District with a value of 1.45; and (3) Dispered pattern with a value of 5.55% located in Bonto Marannu District with the index value of the closest neighbor of 1.79. These results confirm that the dominant pattern of socio-economic activity in Gowa Regency is the random pattern. In conditions of large-scale production and division of labor, the interactive symbiotic relationship between urban and rural areas is reciprocal and mutually beneficial (Segura et al., 2020; Xia and Zhang, 2019; Surya et al., 2021). Furthermore, the spatial entropy index in the Gowa Regency area is presented in Table 9 below.

Table 9 shows the entropy index for the Gowa Regency area. Interpretations that can be proposed for these results include: (1) The lnK value of 2890, with an absolute entropy index (IE) of 3/2890 or an entropy index value of 1.03, (2) the entropy index value shows the distribution pattern of socio-economic activities tends to be evenly distributed for all districts in Gowa Regency. Thus, the relationship between regional resources and the environment as well as human activities plays an important role in sustainable regional development (Aritenang, 2021; Niñerola et al., 2020). Furthermore, the index of concentration and deconcentration of industry activities is presented in Table 10 below.

Table 10 shows the index of industrial activity concentrations in Gowa Regency. The interpretations that can be proposed for these results include: (1) 61.11% of industrial activities in the Gowa Regency area are categorized as evenly distributed and the Pattalasssang District area has the highest index value or equal to 0.71; (2) 38.89% of the industrial activity pattern has a tendency, to be concentrated with the highest index value located in the Somba Opu District area with a value of 22.46. In this context, these processes have, to support sustainable development, guaranteeing the basic needs of the population, through the rational management of natural resources, and without compromising the sustainability of future societies (Surya, 2016). Indeed, industrial processes are considered sustainable when they are innovative and compose safety and waste management (Bouznit, 2020). Furthermore, districts that have certain economic specialties and are supported by the use, of technology will encourage their economic growth (Ahuja, 2019; Surya et al., 2020).

Table 9: Spatial entropy index for socio-economic activities in Gowa Regency

District Area	Total Population (Person)	%	Pi	Pi ln Pi
Bontonompo	44,998	5.88	0.06	−0.167
South Bontonompo	32,118	4.19	0.04	−0.133
Bajeng	72,006	9.40	0.09	−0.222
West Bajeng	26,639	3.48	0.03	−0.117
Pallangga	127,837	16.69	0.17	−0.299
Barombong	45,192	5.90	0.06	−0.167
Somba Opu	156,108	20.39	0.20	−0.324
Bonto Marannu	41,016	5.36	0.05	−0.157
Pattalassang	30,254	3.95	0.04	−0.128
Parangloe	18,628	2.43	0.02	−0.090
Manuju	14,591	1.91	0.02	−0.075
Tinggimoncong	23,332	3.05	0.03	−0.106
Tombolo Pao	29,779	3.89	0.04	−0.126
Parigi	13,289	1.74	0.02	−0.070
Bungaya	16,742	2.19	0.02	−0.084
Bontolempangan	14,781	1.93	0.02	−0.076
Tompobulu	28,393	3.71	0.04	−0.122
Biringbulu	30,073	3.93	0.04	−0.127

Source: Analysis results

3.3. Utilization of Renewable Energy and Improvement of Environmental Quality

Renewable energy is part of the effectiveness and optimization of the use of natural resources in a sustainable manner. This means that renewable energy has a strategic role as an alternative resource to replace non-renewable fossil energy. Global warming and people's behavior in predominantly socio-economic activities using fossil energy will affect climate change and ecosystem balance towards a decrease in the quality of the environment. The consequences of this problem will only intensify if we do not face the realities of climate change; to do this, humanity must achieve some meaningful solutions to address the threat of global warming (Kumar and Tiwary, 2020). Thus, the use of renewable energy in supporting regional development in Gowa Regency has a strategic value and position to be developed and integrated with strengthening the institutional capacity of government and society. This means that the use of renewable energy will involve the role of government and community institutions through the formulation of strategic and participatory programs (Bouzarovski and Petrova, 2015; IRENA, 2020). Furthermore, the capacity of government and community institutions in renewable energy management in Gowa Regency is presented in Figure 6 below.

Figure 6 shows the capacity of government and community institutions in the use of renewable energy in relation to the regional development of Gowa Regency. The interpretations that can be proposed for these results include: (1) The capacity of government institutions in the use of new and renewable energy, giving an illustration of 41.33% for the supportive category, 16% for the sufficiently supportive category, and 42.67% for the not supportive category; and (2) community institutional capacity illustrates that 37.33% is in the supportive category, 16.44% is in the sufficiently supportive category, and 46.23% is in the not supportive category. This figure confirms that efforts are needed to strengthen the institutional capacity of government and society which is optimal in relation to the use of renewable energy towards economic growth and sustainable regional development. The results of the in-depth interviews conducted show that to support the use of renewable energy will require intensive socialization efforts in terms of providing understanding to the community to use renewable energy as an alternative to fossil energy in the direction of improving the quality of the local environment. Thus, government policy support that is not optimal and community understanding is low enough that the implementation of renewable energy utilization has not been

optimal in supporting economic growth and regional development in Gowa Regency. Increased consumption coupled with the use of renewable energy will have an impact on the efficiency of energy resources, if supported by government policies and community participation (Sasmaz et al., 2020). Furthermore, the socio-cultural characteristics of the community in supporting the use of renewable energy are presented in Figure 7 below.

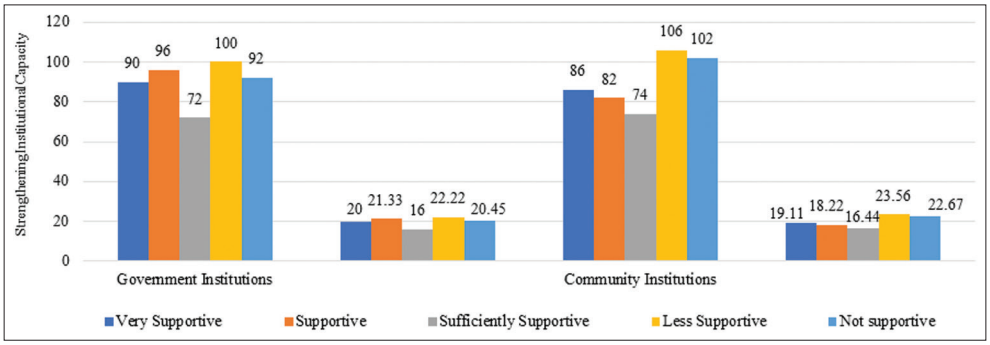
Figure 7 shows the socio-cultural conditions of the community in supporting the use of new and renewable energy in Gowa Regency. Interpretations that can be proposed for these results include: (1) Socio-cultural characteristics through optimizing the use of community social capital in the use of renewable energy, illustrating that 44.45% is categorized as supportive, 24% is in the sufficiently supportive category, and 31.55% is in the not

Table 10: Index of concentration-deconcentration of industrial activities in Gowa Regency

District Area	Area		Number of Industries		X-Y	X-Y (Absolut)	DQ	Information
	Km²	X (%)	Unit	Y (%)				
Bontonompo	30.39	1.61	499	4.87	−3.26	3.26	3.02	Concentrated
South Bontonompo	29.24	1.55	485	4.73	−3.18	3.18	3.05	Concentrated
Bajeng	60.09	3.19	638	6.23	−3.04	3.04	1.95	Concentrated
West Bajeng	19.04	1.01	71	0.69	0.32	0.32	0.69	Equally
Pallangga	48.24	2.56	958	9.35	−6.79	6.79	3.65	Concentrated
Barombong	20.67	1.10	302	2.95	−1.85	1.85	2.68	Concentrated
Somba Opu	28.09	1.49	3429	33.47	−31.98	31.98	22.46	Concentrated
Bonto Marannu	52.63	2.79	580	5.66	−2.87	2.87	2.03	Concentrated
Pattalassang	84.96	4.51	328	3.20	1.31	1.31	0.71	Equally
Parangloe	221.26	11.75	479	4.67	7.08	7.08	0.40	Equally
Manuju	91.9	4.88	83	0.81	4.07	4.07	0.17	Equally
Tinggimoncong	142.87	7.59	389	3.80	3.79	3.79	0.50	Equally
Tombolo Pao	251.82	13.37	346	3.38	9.99	9.99	0.25	Equally
Parigi	132.76	7.05	251	2.45	4.60	4.60	0.35	Equally
Bungaya	175.53	9.32	378	3.69	5.63	5.63	0.40	Equally
Bontolempangan	142.46	7.56	328	3.20	4.36	4.36	0.42	Equally
Tompobulu	132.54	7.04	275	2.68	4.36	4.36	0.38	Equally
Biringbulu	218.84	11.62	427	4.17	7.45	7.45	0.36	Equally

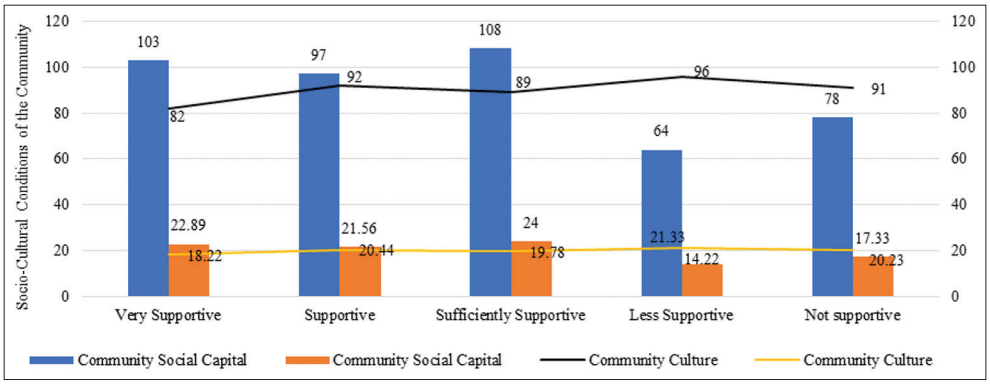
Source: Analysis results

Figure 6: Government and community institutional capacity



Source: Primary Data

Figure 7: Socio-cultural conditions of the community



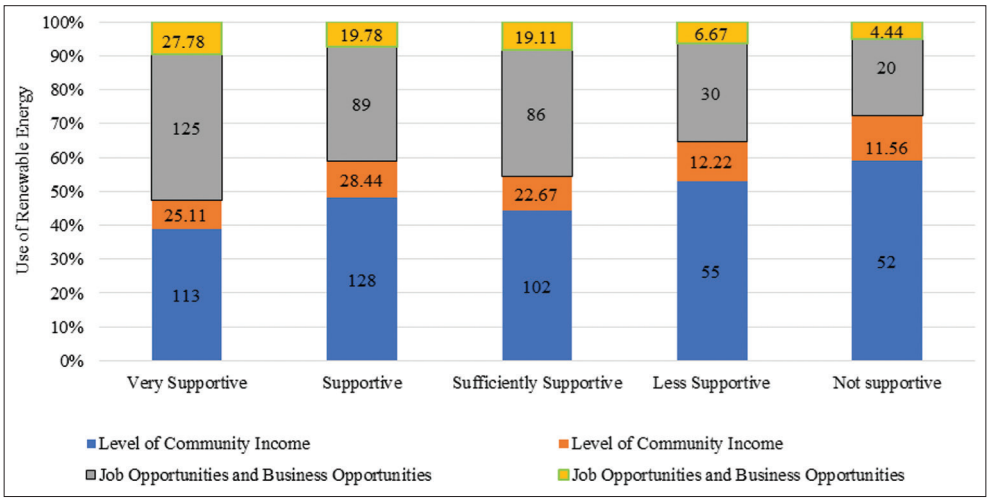
Source: Primary Data

supportive category; (2) the socio-cultural conditions of the community related to the use of new and renewable energy provide an illustration of 38.66% in the supportive category, 19.78% in the sufficiently supportive category, and 41.56 in the not supportive category. This figure confirms that the role of community social capital is very important and strategic in supporting changes in people's behavior towards the use of clean energy in developing economic enterprises. Insufficiency of cleaner and affordable fuel and energy systems is core to energy poverty challenge (Joci´c et al., 2020). The potential solution lies in enabling energy poor communities to use: (1) Clean fuels and (2) clean energy technologies (REN21, 2019). The results of the in-depth interviews conducted illustrate that the use of energy currently used by the community has not fully utilized renewable energy due to limited understanding and knowledge. Thus, intensive efforts are needed to build awareness towards changing behavior in relation to material recycling to be used as renewable energy in support of increasing the productivity of economic enterprises and reducing gas emissions that are produced towards the use of clean energy in a sustainable manner. As such, policymakers, industry investors and the public must focus appropriately on scaling up a number, of options consistent with achieving zero emissions goals, and most of these options rely on renewable energy technologies (Vannevel and Goethals, 2020; Surya et al., 2020). Furthermore, the use of renewable energy in relation to the level of community income, job opportunities and business opportunities is presented in Figure 8 below.

Figure 8 shows the level of income, employment, and business opportunities in relation to the use of new and renewable energy in Gowa Regency. Interpretations that can be proposed for these results include: (1) The use of new and renewable energy in relation to the level of community income, giving an illustration of 53.55% in the supportive category, 226.67% in the sufficiently supportive category, and 23.78% in the not supportive category; (2) job opportunities and business opportunities in relation to the use of new and renewable energy gives an illustration of 47.56% with the supportive category, 19.11% with the sufficiently supportive category, and 11.11% with the not supporting category This figure confirms that the use of renewable energy is positively associated with an increase in community income, job opportunities and business opportunities. The replacement of fossil fuels to the use of renewable energy has a positive impact on the environment, employment opportunities, and the sustainability of economic enterprises (Grossauer and Stoeglehner, 2020). The results of the in-depth interviews conducted show that the use of renewable energy will help the community to create household expenditure efficiency and business management efficiency towards increasing welfare. Thus, the use of renewable energy will create employment and business opportunities, economic growth, reduce unemployment at the productive age and poverty in the direction of regional development stability. Furthermore, energy distribution, energy availability, and renewable energy utilization are presented in Figure 9 below.

Figure 9 shows the distribution, availability, and utilization of new and renewable energy in Gowa Regency. Interpretations that can be proposed regarding these results include: (1) Energy distribution illustrates that 44.22% in the supportive category, 22.67% in the sufficiently supportive category, and 33.11 in the not supportive category, (2) the availability of energy to support economic business and regional activities give an overview of 56.67% in the supportive category, 25.56% in the supportive category, and 17.77% in the not supportive category, and (3) the use of renewable energy to support the sustainability of the area, an image of 54.45% is obtained in the supporting category, 24.44% is quite supportive, and 21.11% categorized as not supportive. This figure confirms that the distribution, availability, and utilization of renewable energy to support socio-economic activities and the continuity of regional development in Gowa Regency are quite adequate. Renewable energy sources are revealed as the solution which should satisfy both needs–a need for energetic stability, as well as a need for producing 'clean' and 'sustainable' energy, and therefore reduce humans' influence on the climate change (Mey and Hicks, 2019). The results of in-depth interviews and field findings indicate that the availability of water, wind, solar and bioenergy energy is sufficiently available in relation to the effectiveness of natural resource utilization and energy crop cultivation to support the development of the Gowa Regency area. This means that meeting people's energy needs and other

Figure 8: Level of income, employment, and business opportunities



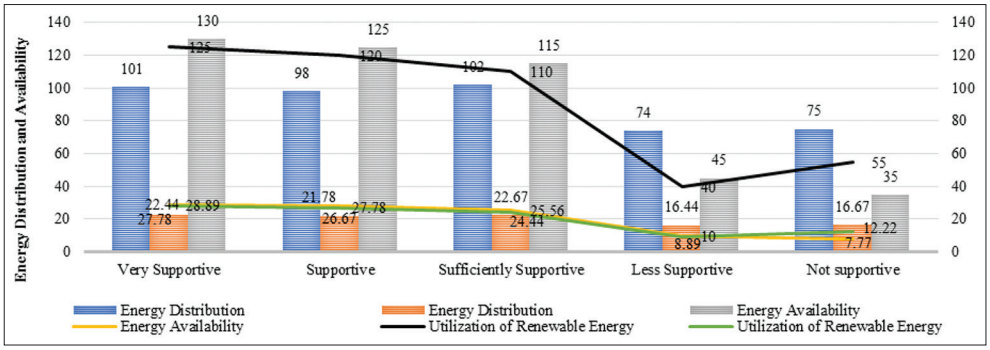
Source: Primary Data

economic enterprises will require decision-making support from the government to develop and optimize the use of renewable energy to support increased regional economic productivity. Furthermore, the coverage of energy services and the availability of energy infrastructure is presented in Figure 10 below.

Figure 10 shows the service coverage and availability of new and renewable energy infrastructure in Gowa Regency. Interviews that can be proposed for these results include: (1) Coverage of energy services related to distance of services and affordability of the community, giving an illustration of 25.55% in the supportive category, 18.22% in the sufficiently supportive category, and 56.23% in the not supportive category, (2) The availability of energy infrastructure illustrates 29.55% in the supportive category, 15.56% in the sufficiently supportive category, and 54.89 in the not supportive category. This figure confirms that the service coverage and availability of renewable energy infrastructure in Gowa Regency are not yet optimal in terms of services received by the community. This means that the use of renewable energy has not been optimized to support various socio-economic activities of the community due to affordability and inadequate support for the availability of infrastructure. For the sustainable energy transition to succeed, two key elements are necessary: renewables must be deployed much more rapidly in the electricity sector, and widespread electrification is needed in all economic sectors, including the end-use sectors of transport, industry, and heating and cooling (Grossauer and Stoeglehner, 2020). The results of interviews and facts found in the field illustrate that one of the factors causing the inadequate coverage of energy services due to the availability of facilities and infrastructure as well as the geographical constraints of the dominant Gowa Regency area is hilly areas and inadequate support for transportation infrastructure, especially in remote rural areas. Furthermore, the effectiveness of natural resource utilization and environmental carrying capacity is presented in Figure 11 below.

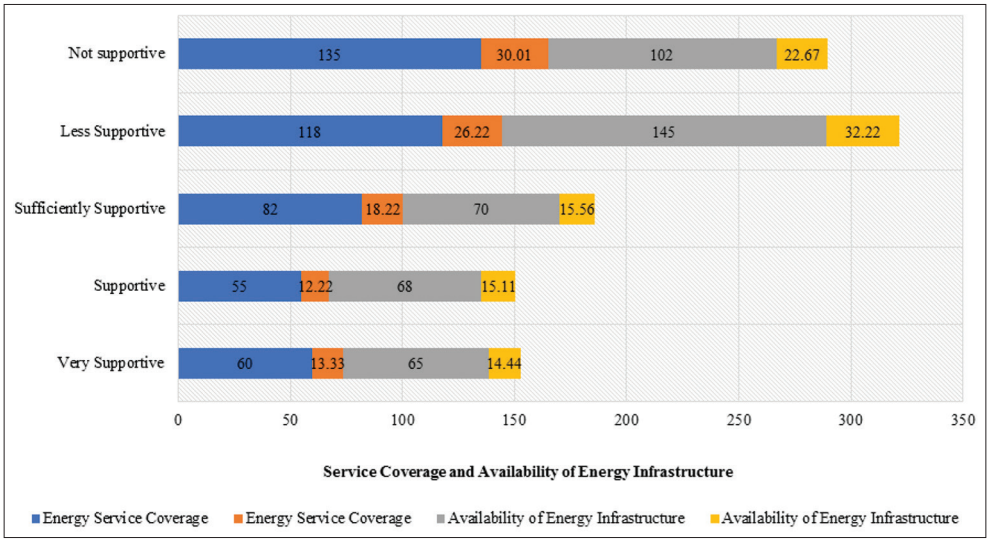
Figure 11 shows the effectiveness of the utilization of natural resources and the carrying capacity of the environment in the Gowa Regency area. Interpretation of these results, among others: (1) The potential of natural resources in relation to the use of new and renewable energy, giving an image of 62.66% in the supportive category, 23.56% in the sufficiently supportive category, and 13.78% in the not supportive category, (2) carrying capacity The environment in relation to the physical condition of the area obtained an overview of 25.55% with the supportive category, 17.33% with the sufficiently supportive category, and 57.12% with

Figure 9: Distribution, availability, and utilization of renewable energy



Source: Primary Data

Figure 10: Service coverage and availability of renewable energy infrastructure

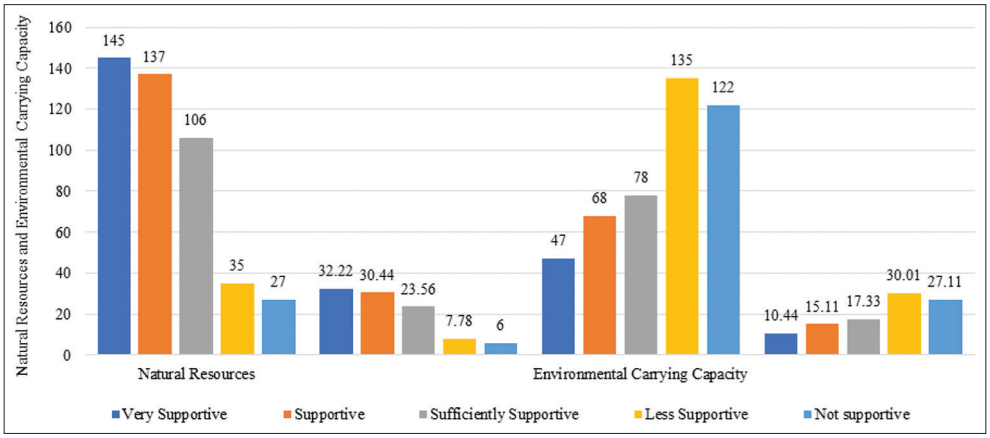


Source: Primary Data

the not supportive category. This figure confirms that the natural resources of the Gowa Regency area are very potential to be utilized and developed to encourage economic growth, but on the other hand the carrying capacity of the environment is categorized as low. Thus, policy formulation is aimed at linking the economy and green economic growth, and ecosystem sustainability (Wagemans, 2019). The results of in-depth interviews show that caution is needed in the use of natural resources in the Gowa Regency area. This condition is closely related to the topographical condition of the area which is in the range of slopes above 40% and is dominant in hilly areas and is very susceptible to land erosion. Furthermore, field findings show that most of the land resources in the Gowa Regency area are classified as critical land, with the following categories: (i) Very critical covering 23,806.36 hectares (13.35%), critical covering an area of 29,147.38 hectares (16.34%), rather critical covering an area of 70,981.35 hectares (39.80%), critical potential is 35,646.08 hectares (19.99%), and non-critical area is 18,300.17 hectares (10.26%). Thus, support for the use of technology is needed to optimize the use of natural resources, followed by conservation of natural resources towards saving the ecosystem. Thus, the conversion of the economic system from fossil to biogenic and renewable resources is seen as an important component of sustainable development (Tjahjadi et al., 2020). Furthermore, community participation and the role of the private sector in the management and utilization of renewable energy is presented in Figure 12 below.

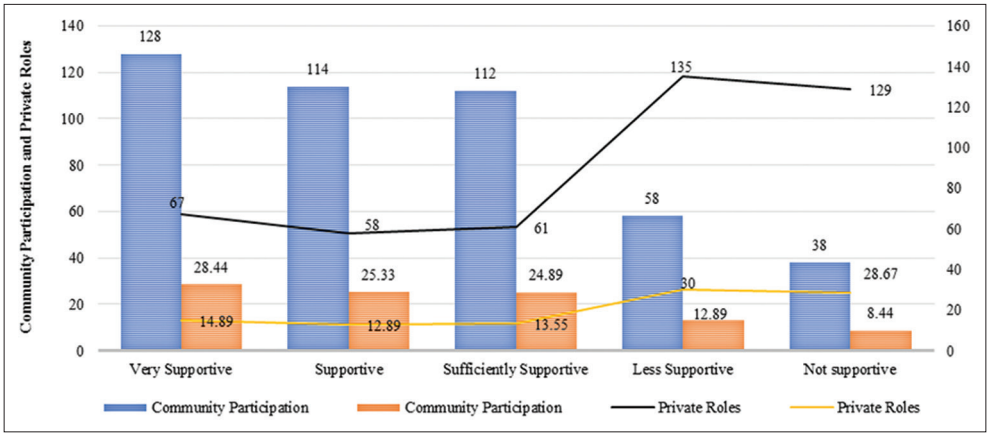
Figure 12 shows the participation of the community and the role of the private sector in the utilization of new and renewable energy in the Gowa Regency area. Interpretations that can be proposed regarding these results include: (1) Community participation in the use of new and renewable energy gives an overview of 53.77% in the supportive category, 24.89% in the sufficiently supportive category, and 21.33% in the not supportive category, (2) the role the private sector in the use of new and renewable energy gave an illustration of 27.78% in the supportive category, 13.55% in the sufficiently supportive category, and 58.67% in the not supportive category. These results confirm that the high interest of the community in utilizing renewable energy is a potential for encouraging the use of clean energy towards increased productivity of economic enterprises and sustainable regional development. Furthermore, the role of the private sector is quite low in supporting the use of renewable energy due to the absence of government regulations in the form of investment cooperation as a basis and reference for private parties in managing renewable energy. The transition to the use of sustainable renewable energy is very important to be integrated through a pattern of investment cooperation between the government, the private sector, and

Figure 11: Natural resources and environmental carrying capacity



Source: Primary Data

Figure 12: Community participation and the role of the private sector



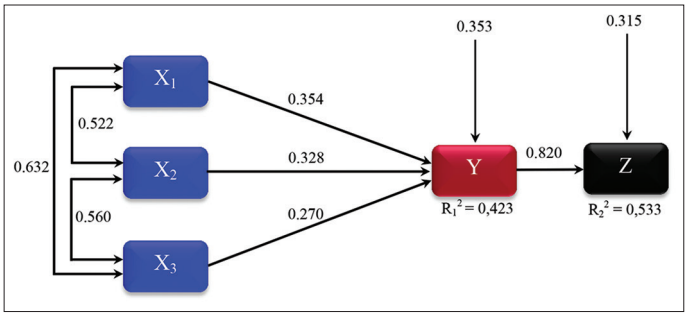
Source: Primary Data

the community (Eras-Almeida and Egido-Aguilera, 2020; Quintana-Rojo et al., 2020). The results of in-depth interviews and field facts that were found illustrate that the government's unpreparedness regarding policies on the use of renewable energy through investment cooperation causes the role of the private sector in supporting the use and management of renewable energy and economic growth in the Gowa Regency area not optimal. Furthermore, the direct and indirect effects of economic growth, the effectiveness of natural resource utilization, and the use of renewable energy on improving environmental quality and (Z) the sustainability of regional development are presented in Figure 13 below.

Several things are explained in relation to Figure 12, among others: First, the correlation between economic growth and the effectiveness of natural resource utilization is 0.522, the correlation between economic growth and the use of new and renewable energy is 0.632, and the correlation between the effectiveness of natural resource utilization on the use of new energy and renewable amount of 0.560 s, the direct effect of economic growth on environmental quality improvement is 12.53%; the direct effect of the effectiveness of the use of natural resources on the improvement of environmental quality by 10.76%; the direct effect of the use of new and renewable energy on improving environmental quality by 7.29%. Third, the indirect effect of economic growth through effective use of natural resources on environmental quality improvement by 6.06%; indirect effect of the effectiveness of natural resource utilization through economic growth on the improvement of environmental quality by 6.06%; indirect effect of economic growth through the use of new and renewable energy on environmental quality improvement by 6.04%; the indirect effect of the use of new and renewable energy through economic growth on the improvement of environmental quality by 6.04%; indirect effect of the effectiveness of natural resource utilization through the use of new and renewable energy on environmental quality improvement by 4.96%; the indirect effect of the use of new and renewable energy through the effectiveness of the use of natural resources on the improvement of environmental quality by 4.96%.

Fourth, the total effect is 64.7%. The residual effect or residue (the influence of the independent variables that were not examined on the improvement of environmental quality) is 1- 0.647 = 0.353 or 35.3%. Furthermore, increasing environmental quality (Y) affects the sustainability of regional development (Z). The direct effect of increasing environmental quality on the sustainability of regional development is 67.24%. Thus, the residual effect or residue (the influence of other variables on the sustainability of the development of the area not studied) is 1−0.6724 = 0.3276 or 32.76%. These results indicate that the effect of economic growth, the effectiveness of natural resource utilization, and the use of renewable energy explains 64.7% improvement in environmental quality with a determination coefficient of 42.3% and the effect of increasing environmental quality explains 32.76% on the sustainability of regional development with determination coefficient of 53.3%. These results indicate an increase from 64.7% to 67.24% (there was an increase of 67.24 to 64.7% = 2.54%). Furthermore, the results of the structural equation modeling (SEM) analysis are presented in Figure 14 below.

Figure 13: Correlation of economic growth, effectiveness of natural resource utilization, and utilization of renewable energy towards improving the quality of the environment and the sustainability of regional development

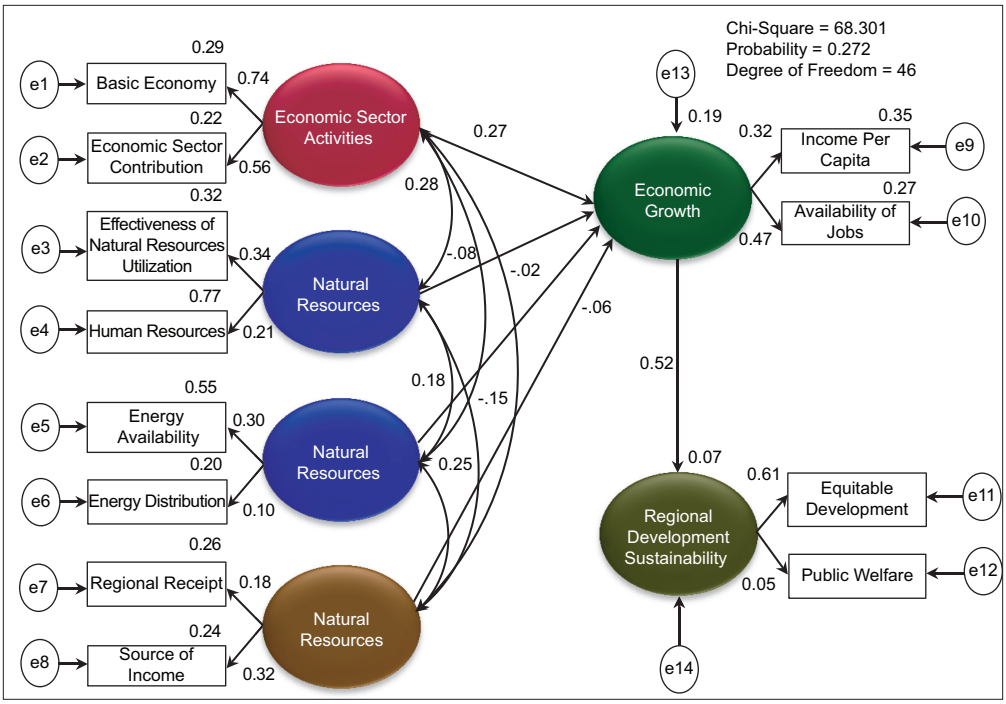


Source: Analysis results.

Figure 14 shows a model of economic growth, natural resource management, utilization of renewable energy, and sustainable development of the Gowa Regency area. Interpretations that can be put forward to the model include: First, the construct (latent variable) of the economic activity sector, natural resources, renewable energy, and economic productivity significantly determines economic growth and sustainable development of Gowa Regency. The structural model built statistically fulfills the requirements as a fit model to illustrate that economic growth with a value of P = 0.272 >0.05 with a degree of freedom value of 46. Second, the effect of the total construction sector of economic activity on the endogenous variables of economic growth is 95.24%, natural resources to the endogenous variable of economic growth of 37.93%, the use of renewable energy to the endogenous variable of economic growth of 47.94%, and economic productivity of the endogenous variable of economic growth of 14.86%. Furthermore, the total influence of economic activity sector constructs on the endogenous variable of regional development sustainability is 98.14%, natural resources on the endogenous variable of regional development sustainability is 25.86%, the use of renewable energy on the endogenous variable of regional development sustainability is 47.13%, and economic productivity on the endogenous variable of sustainability, regional development by 14.98%. The total effect of the endogenous variables of economic growth on the endogenous variables of regional development sustainability is 27.04%.

The orientation of the future development of the Gowa Regency area is divided into four categories, namely: (1) The sector aspect of economic activity is focused on optimizing the regional economic base sectors and increasing the contribution of the strategic economic sector; (2) The aspect of natural resources is focused on two important things, namely the effectiveness of the use of natural resources and strengthening the capacity of human resources; (3) The use of renewable energy is focused on two main things, namely the availability of energy and the distribution of energy services; and (4) Increasing economic productivity is focused on two main things, namely increasing regional revenues, and optimizing new sources of income. Increasing future economic growth is oriented towards two strategies, namely (i) increasing

Figure 14: Economic growth model, utilization of renewable energy, natural resource management, and sustainable development for Gowa Regency



Source: Analysis results.

people's income, and (ii) opening new job opportunities for the community. Furthermore, the sustainability of the future development of the Gowa Regency area requires two main things, namely (i) equitable development, and (ii) improving community welfare.

3.4. Renewable Energy and Regional Development

The increasing trend of economic growth is closely related to meeting energy needs to ensure economic stability towards optimizing the sustainable use of natural resources. The use of renewable energy is a strategic solution to increase the productivity of economic enterprises, which requires the support of regional development policies towards investment cooperation between the government, the private sector, and the community. Thus, the use of renewable energy will boost the productivity of community economic enterprises in various sectors towards energy security. Furthermore, with reference to economic growth and the increasing population that tends to increase in the Gowa Regency area, the orientation of the use of green energy that is environmentally friendly will become short-term and long-term demands. Therefore, the green market plays a crucial role for companies in the era of sustainability. The green market refers to a market where consumers and competitors are aware of environmentally friendly products and processes (Surya et al., 2020). The development of the Gowa Regency area which is dominant in an economic direction followed by the optimization of regional-based sectors, namely industry, tourism, trade and services, education, and community economic enterprises will have an impact on the high demand for energy. In order, to anticipate a decrease in environmental quality as a result, of excessive use of fossil energy, the use of new and renewable energy to improve environmental quality is part of fulfilling the targets for sustainable development goals (SDGs). Furthermore, the implementation of SDGs through the use of renewable energy to support the regional development of Gowa Regency is oriented towards three main principles, namely (i) equitable energy distribution, in this case it is affordable to all levels of society, (ii) fulfilling energy needs through energy infrastructure support and transportation infrastructure, especially for abandoned rural areas, and (iii) arrangement of spatial zones to facilitate the attainment of public access to locations for socio-economic activities that are integrated with the distribution of energy services in a sustainable manner. Energy systems in the future will require stakeholder involvement, technological innovation, and the application of technical quality procedures towards the distribution of meeting energy needs in a sustainable manner (Surya et al., 2020).

The implementation of regional development that is integrated with the use of renewable energy towards energy security is an important element in realizing economic growth in the Gowa Regency region. This means that energy security is a strategy and government policy that ensures the availability of energy and public access to energy at affordable prices for the long term and is not affected by regional and international economic shocks. Furthermore, energy needs in the agriculture, industry, trade, and service sectors will continue to dominate the economic growth of Gowa Regency in the long term. These sectors of economic activity will need support for transportation services in relation to the distribution of the flow of goods and services as well as energy. Thus, the opportunity to take advantage of renewable energy is very strategic in supporting the economy of the Gowa Regency region in the future. Thus, policy formulation is oriented towards strategic plans in the direction of using renewable energy into concrete development policies (Fuentes et al., 2020). The use of

renewable energy in the dimensions of regional development in Gowa Regency will have an impact on four important and strategic matters, namely: First, social impacts, namely a healthier living environment, technological advances, employment, and business opportunities for the community. This means that renewable energy resources, namely water, wind, and sunlight are classified as environmentally friendly, and the level of environmental pollution is categorized as low. Thus, an equitable distribution of renewable energy fulfillment is needed in order, to reduce social inequality and regional disparity. Second, the economic impact, in this case renewable energy development, will create new jobs, benefit material suppliers, and revive the economy simultaneously on the one hand. On the other hand, the use of renewable energy has a long-term impact in terms of the efficiency of development financing. To achieve this, it requires investment cooperation between the government and the private sector which is mutually beneficial.

Third, the environmental impact, the use of renewable energy will have an impact on improving the quality of life in a sustainable manner. Utilization of renewable energy, namely sunlight, wind, and water through, the use of environmentally friendly technology will reduce pollution in the form of carbon dioxide gas and reduce gas emissions towards adaptation to global climate change. Fourth, the network impact, in this case the use of renewable energy, requires a different grid system compared to conventional energy utilization. This means that renewable energies such as solar, water and wind are classified as unstable in terms of energy supply, considering that their energy supply depends on climatic and weather conditions. Thus, support for the development of an energy infrastructure network system is needed to ensure the availability of energy supplies. The transition to the use of renewable energy requires the support of modern infrastructure to ensure the security of energy distribution through government policy support (Leiren et al., 2020). Utilization of new energy sourced from bio-cultivation in Gowa Regency is basically intended to ensure the fulfillment of people's energy needs as a substitute for fossil fuels which reserves are very limited. Biodiesel is used as a substitute for diesel and industrial diesel oil. Bioethanol is ethanol produced from biomass to be used as a substitute for gasoline. Meanwhile, biooil is used as a substitute for kerosene and fuel oil. The use of new and renewable energy will require strategic steps in its implementation, namely (i) application of mandatory standards, in this case health, security, safety, and the environment, (ii) support for technician competence in the use of renewable energy, in this case a labor force have expertise in the provision and utilization of renewable energy, (iii) government policies in terms of market intervention through providing incentives or disincentives for communities, business actors, and industry players who use renewable energy. Government policy recommendations are aimed at encouraging environmental quality improvement (Armeanu et al., 2017, Surya et al., 2020).

3.5. Regional Development Sustainability

Excessive use of natural resources together with the use of non-renewable fossil energy causes a decrease in the quality of the environment and scarcity of energy, an increase in greenhouse gases, such as CO_2, sulfur, methane (CH4), nitrogen, infrared radiation, and the effects of global warming. Furthermore, the effectiveness of natural resource utilization followed by the use, of renewable energy will have an impact on economic stability and environmental diversity as only part of the environmental ecosystem system. Thus, economic growth in relation to the use of renewable energy will contribute positively to the sustainable development of the Gowa Regency area. Energy is essential for economic progress, but increasing population tends to increase demands for more energy generated from konventional resources, rising prices, and environmental concerns, thus negatively impacting sustainable economic growth (Surya, 2020). The sustainability of regional development in Gowa Regency will require government policy support in relation to economic growth. Furthermore, the use of renewable energy will require strategic steps, including: (1) Increasing the productivity of economic enterprises through the distribution of goods and services, (2) developing transportation infrastructure for easy accessibility and mobility, (3) optimizing the use of productive labor towards increasing income and community welfare through the opening of job opportunities and business opportunities in a fair manner, and (4) optimizing the use of community social capital towards creating social cohesion and building a sense of togetherness and fulfillment of community rights in a sustainable manner.

These four things will lead to economic stability towards sustainable development, namely economic, social, and environmental issues. Furthermore, the implementation of sustainable development with relevance to economic growth in Gowa Regency, among others: First, ensuring the existence of natural resource sustainability, namely ecological sustainability, which is carried out through three main principles, namely (i) maintaining the integration of environmental and biodiversity structures (ii) maintaining the integration of environmental arrangements so that the life support system is guaranteed, and (iii) optimizing the use of biodiversity based on the use of renewable energy. Second, economic sustainability falls into two main categories, namely (i) macroeconomics in ensuring a sustainable economy and promoting economic efficiency through structural reforms towards the authority to use natural resources, (ii) sector economics, in optimizing the utilization of natural resources based on new energy and renewable towards improving the welfare of the community. Third, socio-cultural sustainability through four main principles, namely (i) population stability, (ii) meeting the basic needs of the community, (iii) maintaining cultural diversity, and (iv) participation of local communities in decision making.

4. CONCLUSION

Economic growth coupled with the effective use of natural resources and support for the use of renewable energy will boost regional productivity and community welfare. Optimizing the use of natural resources will require integrated government policy support with strengthening the capacity of human resources towards meeting energy needs coupled with job creation, reducing gas emissions, and improving environmental quality. Economic growth and regional productivity in Gowa Regency are very important to be developed towards the use of green energy that is environmentally friendly, through three main principles, namely

(i) equitable and affordable energy distribution by all levels of society, (ii) meeting energy needs through infrastructure support energy and transportation infrastructure, especially for services in remote rural areas, and (iii) arrangement of spatial zones to facilitate the attainment of public access to locations of socio-economic activities that are integrated with the distribution of energy services. Furthermore, government policy support is needed in terms of market intervention through providing incentives or disincentives for the community, business actors and industry players to use and utilize renewable energy.

The orientation of the future development of the Gowa Regency area is divided into four categories, namely: (1) The sector aspect of economic activity is focused on optimizing the regional economic base sectors and increasing the contribution of the strategic economic sector; (2) The aspect of natural resources is focused on two important things, namely the effectiveness of the use of natural resources and strengthening the capacity of human resources; (3) The use of renewable energy is focused on two main things, namely the availability of energy and the distribution of energy services; and (4) Increasing economic productivity is focused on two main things, namely increasing regional revenues and optimizing new sources of income. In order, to optimize the utilization of natural resources towards increasing future economic growth, two strategic steps were developed, namely (i) increasing community income, and (ii) opening new job opportunities for the community. Furthermore, the sustainability of the future development of the Gowa Regency area requires two main things, namely (i) equitable development, and (ii) improving community welfare.

In its implementation, the development of the Gowa Regency area requires efforts to strengthen the institutional capacity of the government and the community in relation to the use of renewable energy towards sustainable regional development. Furthermore, sustainable regional development requires effective utilization of natural resources and optimizing the use of social capital in synergy with changes in people's behavior towards the use of clean energy in developing economic enterprises, creating job opportunities and business opportunities, reducing the unemployment rate of productive age and population poverty towards stability regional development. Thus, the use of renewable energy is the potential to move the community in the use of clean energy based on improving environmental quality followed by the optimization of the private sector's role in supporting the use of renewable energy through collaborative investments in the management and utilization of renewable energy. The sustainability of natural resource management and regional development in Gowa Regency requires strategic steps, including: (i) Increasing economic business productivity, (ii) accessibility and mobility, (iii) increasing community income and welfare, and (iv) cohesion social. Furthermore, the implementation of regional development towards sustainable management of natural resources and economic growth of Gowa Regency includes four important things that need to be followed up, namely: (1) Ensuring the potential of natural resources and the environment to remain sustainable; (2) Stability of macro and sectoral economic growth; and (3) Socio-cultural sustainability. Thus, economic growth, effective use of natural resources, and the use of renewable energy will ensure economic stability, and sustainable development of the Gowa Regency area in the future.

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