

## Spatial Planning of Renewable Energy-Based Minapolitan Region

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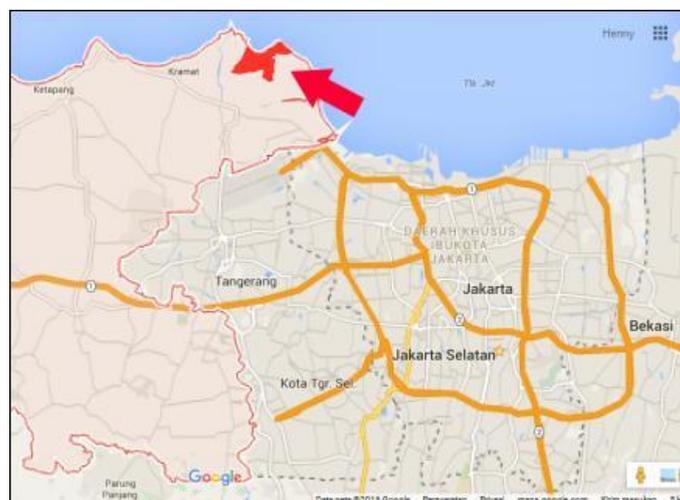
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**Abstract.** Minapolitan derived from the word '*mina*' which means fisheries, and '*politan*', means multi-activities. *E3i* village concept (Energy, Economy and Environment Independent) aims at empowering rural communities to have access to renewable energy for the improvement of economic and production activity in the development of sustainable environment. This concept is intended to create a self-helping spirit among rural communities who have lived so long in poverty and lack access to basic energy needs. Meanwhile Minapolitan region is a region that has the main function of the economy consists of production centers, processing, marketing of fishery commodities, services, and / or other supporting activities. Tanjung Pasir village in the district of Teluk Naga, Tangerang regency, Banten province is a coastal village whose majority are fishermen. The village is great potential to be the Minapolitan. This study intends to revitalize the area of Tanjung Pasir through *E3i* concept and Minapolitan by renewable energy as the source of energy.

### Introduction

The research location is Tanjung Pasir Village, Teluk Naga District, Tangerang Regency, Banten Province. Tanjung Pasir is a coastal village in Tangerang Regency, precisely in Teluk Naga District. The name 'Tanjung Pasir' originates from 'Tanjung' which means the land that stands out to the Java Sea and 'Pasir' because of its sandy sloping beach surface. During the Dutch and Japanese colonies this area was once used as a fortress while at present it is used as a training area for the Navy. At present Tanjung Pasir beach is one of the main tourist attractions in Tangerang Regency. The village has a distance of 6.9 km from the district government center, while from the Regency Capital or Tigaraksa city it is 44 km away. Administratively, this village is divided into 6 (six) areas of independence / dukuh namely *Kemandoran 1*, *Kemandoran 2*, *Kemandoran 3*, *Kemandoran 4*, *Kemandoran 5* and *Kemandoran 6*. Distance from DKI Jakarta province +43 km. The area is +5.70 km<sup>2</sup> or +570 Ha[1].



**Fig. 1** Location of Tanjung Pasir village.

The majority of the livelihoods of the residents of Tanjung Pasir Village are fishermen. The number of people who work as fishermen reaches 1,759 people. This is in accordance with the characteristics of the village area in the coastal area, so that the livelihood of the population is dominated as fishermen[2]. Whether you have your own boat or work as a ship owner crew. One factor in declining income is the existence of 3 months of fish famine (December-February) so that the catch decreases even the fishermen do not go to sea.

The road facilities in Tanjung Pasir Village, especially in Tanjung Pasir Village, are generally asphalt roads with conditions that are slightly hollow and muddy when it rains.



**Fig. 2** Road conditions in Tanjung Pasir village and garbage at the fishing pier.

The tourism sector is still lacking in attention in Tanjung Pasir, even though its location is on the north coast of Java Island which offers a calm view of the Java Sea with views of several small islands which are part of the Thousand Islands, DKI Jakarta province, namely Rambut Island and Untung Jawa Island. The condition of Tanjung Pasir beach is dirty, poorly maintained and does not have an adequate dock for tourists who want to take a boat to sail, fish or cross to the island.

## Literature Review

**Energy, Economy and Environment Independent (*E3i*).** The Grand Theory in this study was *E3i* (Energy, Economy and Environmental Independent). The *E3i* concept aims to empower rural communities to have access to renewable energy for economic improvement and production activities in environmentally sustainable development. This concept is intended to create a spirit of self-help among rural people who have lived so long in poverty and lack access to meet basic energy needs, especially in recent years where oil prices have been erratic. Indonesia is an oil importing country, so the need to utilize local renewable energy sources is becoming an increasingly important issue. Every *E3i* village can connect with each other making it easy for them to exchange their products or work together to manage larger farms or industries. They can also work together to supply materials to small cities, which ultimately makes the village grow with increasingly complete infrastructure[3].

**Minapolitan Concept.** Minapolitan is a regional-based conception of maritime and fisheries economic development based on integrated principles, efficiency, quality and acceleration. Minapolitan area is a part of the region that has the main economic function consisting of production, processing centers, marketing of fishery commodities, services, and / or other supporting activities.

**Sustainable Spatial Planning.** Sustainability is that the use of energy and materials in urban areas is balanced with what is available in the area continuously. The direct implication of this principle is that the energy budget is far reduced for cities, and more simple and compact spatial patterns accompanied by productive living habits such as independent energy production, maintaining plants as food and recycling waste[4].

## Research

### Existing Analysis

**Social Economy.** The majority of education levels are junior high school graduates. The number of Tanjung Pasir residents with a comparison between Fishermen: Non Fishermen is 71%: 29%.

**Infrastructure.** Analysis of infrastructure includes:

1. Tanjung Pasir Village can be accessed by land transportation namely two-wheeled and four-wheeled vehicles, or the sea by boat. The condition of the road to the village is good, but after entering the village the road conditions are poor, many are damaged.
2. Electrification ratio in Tanjung Pasir village has reached 100%, with electricity from PLN.
3. Ground water. Brackish ground water conditions. For now, residents get clean water supplies from the PDAM. Procurement of drinking water from cooking water and buying bottled water.
4. Port. The category is Fish Landing Base/ *Pangkalan Pendaratan Ikan* (PPI) or D class Fisheries Port.

**Energy Potential.** Wind and solar energy the most potential energy source. With the RET screen software we find out the average wind speed is 3.8 m/sec. While the average solar radiation is 5.69 KWh/m<sup>2</sup>/ sec.

**Site Condition.** The site where the spatial plan will be made is in the *Kemandoran* 1 Tanjung Pasir Timur which consists of 2 RW (RW) and 5 Rukun Tetangga (RT). The area of the site is 18.6 ha.

1. Circulation. The main access to the location is a width of 6 meters road, can be traversed by four-wheeled vehicles and has public transportation, namely *angkot*.
2. Landmark. Fisherman Wharf, Fish Auction Place (TPI), Tanjung Pasir Village Head Office, Tanjung Pasir 1 Elementary School Building, Indonesian Naval Base which are open to residents and tourists and are known as Pantai Tanjung Pasir.
3. Zoning. Current zoning in Tanjung Pasir Timur *Kemandoran* 1 consists of 5 (five) areas, namely trading, residential, institutional, industrial and tourist areas[5].



Fig. 3, Zoning in Kemandoran 1.

**Scenario.** The spatial planning scenario is based on an analysis of what facilities are needed by Tanjung Pasir village based on the E3i Concept or Energy, Economy and Environment Independent.

**Economy.** Fisheries Sector. Fisheries is the main economic activity in Tanjung Pasir. From the results of the SWOT analysis, the needs in the fisheries sector are:

1. A more adequate port of fisheries with dock facilities, port management offices, ice cube production sites, toilets and prayer rooms for the public.
2. A more adequate *TPI* (Fish Auction Place), which has fish shelter and dryer facilities. The auction time is every day from 07-11 WIB.
3. Seafood market (fish market), intended for transactions between sellers and buyers outside the auction time.

Tourism Sector. Tourism is a companion economic activity but it is also important to sustain the life of the people of Tanjung Pasir. From the results of the SWOT analysis, it is known that the facilities needed in the tourism sector are:

1. Food court for tourists who need to eat or just a culinary tour. The food court consists of several food stalls, dining rooms and public toilets.
2. Souvenir shop, in the form of several kiosks that sell products both for tourists and souvenirs.
3. Tourist boat, to lean on the shipping vessels of visitors who want fishing trips or cross to the island of Thousand.
4. Lodging, in the form of several cottages to meet the needs of visitors for accommodation.

**Energy.** From the results of the survey and the data obtained the fact that the population of Tanjung Pasir has 100% fulfilled their electricity needs. Therefore the procurement of energy in this study is only for the planned new facilities. Through the method of calculating building electricity requirements, namely:

$$\text{Power requirements (watts)} = \text{Area (m}^2\text{)} \times \text{Standard Power (watts / m}^2\text{)} \quad (1)$$

Then it will be obtained:

$$\text{Total Electricity Requirement} = W1 + W2 + W3 + W4 + W5 + W6 + W7 \quad (2)$$

Based on the results of the analysis, the greatest energy potential in Tanjung Pasir is Wind Energy, so the need for electricity supply in this area will be carried out by building a Wind Energy Power Plant (*PLTB*). The sun's potential is also used for energy needs in the Solar Fish Dryer facility, Solar Street Lamp and Solar PV Rooftop.

**Environment.** Environmental planning in the form of improving environmental management through good cooperation between government officials, facility managers and the community.

**Planning**

**Electricity Planning.** According to the scenario, 7 (seven) facilities is planned to be built in Tanjung Pasir. Based on this scenario, the amount of electricity needed is also calculated. (Bone BAPPEDA & UNHAS, 2000). Calculation of estimated power needed by buildings is:

$$\text{Power requirements (Wh)} = \text{area (m}^2\text{)} \times \text{standard power (W / m}^2\text{)} \times \text{duration (h)} \tag{3}$$

**Table 1.** Plans for electric power requirements.

NO	AMENITIES	TYPE OF BUILDING	AREA (m2)	POWER STANDARD / m2 (watt/m2)	DURATION (hour)	TOTAL POWER (Wh)
1	Class D port	Offices				
	- Pier		630	60	12	453,600
	- Freezer		LS	6,000	24	144,000
	- SPBN		150	60	24	216,000
	- Office		120	60	10	72,000
	- Toilet and mosque		100	60	24	144,000
2	Fish auction	Trading				
	- Solar fish dryer		50	100	12	1,200
	- Auction room		150	60	3	27,000
3	Seafood market	Trading	200	60	5	60,000
4	Food court	Trading	240	60	7	100,800
5	Souvenir kiosk 20 units	Trading	320	60	7	134,400
6	Tourist Pier	Public service	100	30	4	12,000
7	Lodging					
	- 10 unit cottages	Type B building	600	25	12	180,000
	- Managing office	Offices	100	60	12	72,000
8	Power house	Type B building	100	25	12	30,000
	TOTAL		2,860			1,647,000

The amount of electricity needed for all facilities planned above is 1,647,000 Wh or 1,647 KWh. The electricity supply is through a Wind Energy Power Plant (*PLTB*).

**Estimates of Future Energy Needs with LEAP.** LEAP or Low Range Energy Alternative Planning is a tool to help determine the energy needs of a project in the future. If the population is 9,168 people with a growth ratio of 2.65%, and an economic growth ratio of 7.40%, then the prediction is [6]:

**Table 2.** Table of LEAP predictions of electricity demand in the fisheries sector.

Variable: Sektor perikanan: Total Final Energy Consumption (Kilowatt-Hour)											
Scenario: Basic											
Branch: Demand/Penduduk lokal/Sektor perikanan											
Region: Region 1											
Branches	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
TPI	28.2	28.9	29.7	30.5	31.3	32.1	33.0	33.9	34.8	35.7	36.6
Pelabuhan	1,029.6	1,056.9	1,084.9	1,113.6	1,143.2	1,173.4	1,204.5	1,236.5	1,269.2	1,302.9	1,337.4

At the tourism sector, if the number of tourists visiting is 350,000 per year with the same economic growth ratio of 7.40%, then predictions according to LEAP are [7]:

**Table 3.** LEAP table estimates of electricity needs in the tourism sector.

Variable: Sektor pariwisata: Total Final Energy Consumption (Kilowatt-Hour)											
Scenario: Basic											
Branch: Demand\Wisatawan\Sektor pariwisata											
Region: Region 1											
Branches	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Seafood market	60.0	64.4	69.2	74.3	79.8	85.7	92.1	98.9	106.2	114.1	122.5
Penginapan	252.0	270.6	290.7	312.2	335.3	360.1	386.7	415.4	446.1	479.1	514.6
Kios souvenir	134.4	144.3	155.0	166.5	178.8	192.1	206.3	221.5	237.9	255.5	274.4
Dermaga wisata	42.0	45.1	48.4	52.0	55.9	60.0	64.5	69.2	74.4	79.9	85.8
Food court	100.8	108.3	116.3	124.9	134.1	144.0	154.7	166.1	178.4	191.6	205.8

### PLTB Planning

**Table 4.** Planning of Tanjung Pasir PLTB.

project:	Tanjung Pasir						
site:	Tangerang - Banten						
WET:	50KW						
WET:	Pr :	50 [kW]	rotor diameter	Dr :	20.00 [m]		
hub height	Hh :	30.00 [m]	swept area	Ar :	314.16 [m <sup>2</sup> ]		
annual wind speed	U10	5.00 [m/s]	air density	rh :	1.225 [kg/kub.m]		
annual wind speed	Uh :	6.74 [m/s]	scale parameter	A :	7.61 [m/s]		
annual energy product	E :	153,338 [kWh/a]	shape param	k :	2.00 [-]		
			annual operating hour	h :	7863 [h/a]		

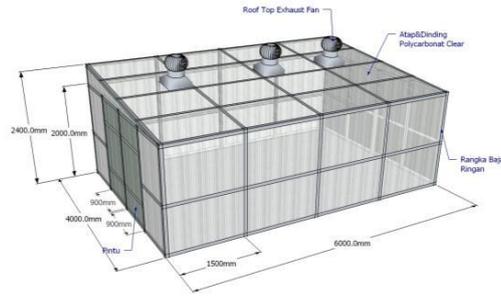
u [m/s]	[hour/year]	[kW]	[kWh]	cp [-]
1	296			
2	563			
3	775	0.50	387	0.10
4	916	1.00	916	0.08
5	980	5.00	4900	0.21
6	973	10.00	9729	0.24
7	907	16.00	14514	0.24
8	800	24.00	19212	0.24
9	672	29.60	19885	0.21
10	538	37.50	20173	0.19
11	412	46.40	19117	0.18
12	302	50.00	15117	0.15
13	213	50.00	10643	0.12
14	144	50.00	7196	0.09
15	94	50.00	4677	0.08
16	58	50.00	2923	0.06
17	35	50.00	1758	0.05
18	20	50.00	1018	0.04
19	11	50.00	568	0.04
20	6	50.00	305	0.03
21	3	50.00	158	0.03
22	2	50.00	79	0.02
23	1	50.00	38	0.02
24	0	50.00	18	0.02
25	0	50.00	8	0.01

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Needs in the Tj.Pasir (KWh) Region	1647
Energy produced (KWh)	420.1
Total Wind Turbines needed	3.9
Wind Turbines installed	4 units of Scale 50 KW

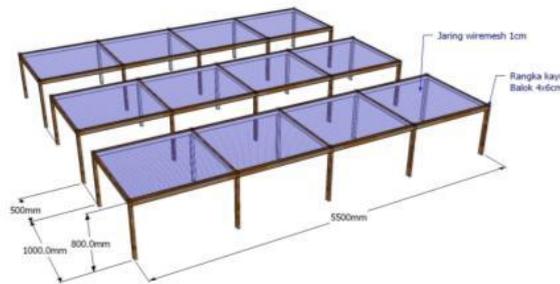
From the table it can be seen that the total electricity demand is 1,647 KWh. If the wind turbine is planned to have a capacity of 50 KW with a diameter of 20 m and a height of 30 m, then the number of wind turbines needed is 4 units.

### Solar Energy Planning

- Solar Fish Dryers. The size of the solar dryer is 6x4 m<sup>2</sup>. For TPI facilities, 2 units will be built.



**Fig. 14** Solar dryer fish dryer.



**Fig. 15** Dryer rack.

- Solar Street Lamp. If we need 1 solar street lamp 80 wp for each area of 100 m<sup>2</sup>, then:  
Solar street lamp needs =  $2540 \text{ m}^2 / 100 \text{ m}^2 = 25.4 = 25$  pieces.

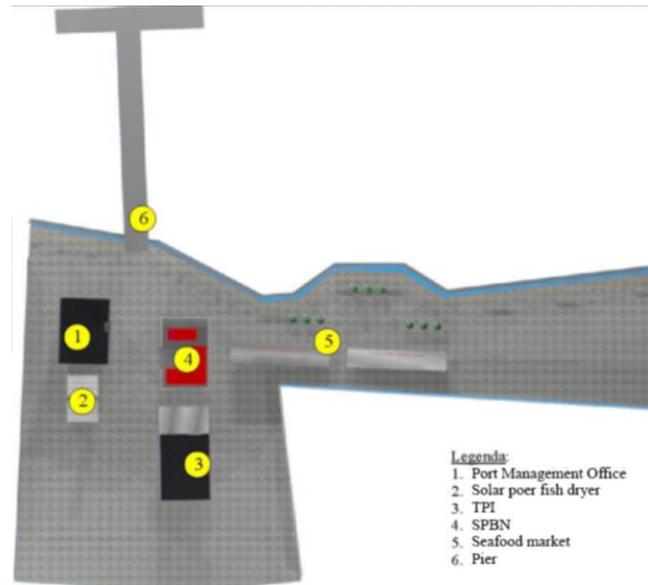
## Design

**Master Plan.** The spatial design in the master plan will be divided into 3 zones according to the functions and grouping of activities, namely the Fisheries, Tourism and the Energy Zone.

**Fishery Zones.** The Fisheries Zone has a land area of 5000 m<sup>2</sup>, consisting of a Port area with an area of 1000 m<sup>2</sup> and a Seafood Market, which are: Port Management Office, Freezer or ice factory, Solar power fish dryer, *TPI* (Fish Auction Place), *SPBN* (Fisherman Refueling Station), Fishing boats, Seafood market, has an area of 200 m<sup>2</sup>.



**Fig. 16** Tanjung Pasir Master Plan.



**Fig. 17** Site plan of the Port Zone.

**Tourism Zone.** The Tourism Zone consists of the Lodging Area and Tourism Beach Area.

1. Lodge Area has a land area of 4700 m<sup>2</sup>, 10 cottages @60 m<sup>2</sup> and 1 management office.
2. Tourism Beach Area has a land area of 2 hectares and consists of Tourist pier for ships that serve crossing the Tanjung Pasir route - Untung Jawa Island and Tanjung Pasir - Pulau Rambut, Food court (floating), Souvenir stall 20 units, the tourist beach management office, is a 50 m<sup>2</sup> room which is a part of the Power House building, Public Toilet which is also part of the Power House building.

**Energy Zones.** The Energy Zone is the most important part of the plan, which consists of 4 units of 50 KW wind turbines PLTB, solar power fish dryer consisting of 2 units, and 25 units of 80 watts solar street lamp.



**Fig. 18** Energy master plan for Tanjung Pasir village.

## Conclusions

From the results of the analysis and discussion in this study, there are some conclusions:

1. Tanjung Pasir Village and other traditional coastal villages in Indonesia can be converted into an E3i concept minapolitan area, by conducting a study of local production potential for the purpose of increasing the income of the people, and their natural potential with the aim of utilizing this potential into a renewable energy source.
2. To make it a minapolitan area, the traditional coastal village layout must be adjusted.
3. The appropriate spatial model for a renewable energy-based minapolitan area is to arrange it or divide it into 3 zones, namely: Fisheries Zone, Tourism Zone and Energy Zone.

## **References**

- [1] APPEDA-Tangerang. (2010). Rencana Pembangunan Jangka Panjang Daerah Kabupaten Tangerang. Tangerang BAPPEDA.
- [2] BAPPEDA-Tangerang. (2012). Kabupaten Tangerang dalam Angka. Statewide Agricultural Land Use Baseline 2015, 1. doi:10.1017/CBO9781107415324.004
- [3] Abdullah, K. (2008). The E3i Village Concept. 2008. Retrieved from <http://download.portalgaruda.org/article.php?article=61724&val=4555>
- [4] Ryn, S. Van der, & Peter Calthorpe. (1986). Sustainable Communities: A New Design Synthesis for Cities, Suburbs and Towns | Calthorpe Associates. Retrieved May 19, 2016, from <http://www.calthorpe.com/publications/sustainable-communities>
- [5] BAPPEDA-Tangerang. (2008). Rencana Pembangunan Jangka Panjang Daerah Kabupaten Tangerang. Tangerang BAPPEDA.
- [6] BAPPEDA-Tangerang. (2007). Kabupaten Tangerang dalam Angka 2007 / 2008 Tangerang Regency in Figures 2007 / 2008.