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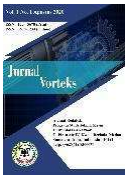

APPLICATION OF RENEWABLE ENERGY ARCHITECTURE APPROACH IN THE DESIGN OF NUSANTARA ENERGI KREATIF IN TEMBUNG VILLAGE, KECAMATAN PERCUT SEI TUAN, KABUPATEN DELI SERDANG

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Abstrac

The Micro, Small and Medium Enterprises (MSMEs) sector plays an important role in the Indonesian economy, but is often constrained by unsustainable energy access and high operational costs. Tembung Village in Deli Serdang Regency has potential local resources such as solar energy, kinetic energy and biomass that have not been optimally utilized. This research applies the renewable energy approach in the design of the UMKM center (Nusantara Energi Kreatif) to empower the community while integrating technology, sustainability, and community values in harmony. The design integrates solar panel systems, paving tiles (kinetic energy), and biomass as the main energy sources, passive design (natural lighting), environmentally friendly materials (Albasia wood, low-E glass), and integrated rainwater and waste management. The flexible space concept (co-working space, training, exhibition) is designed to encourage collaboration and innovation of MSMEs. Nusantara Energi Kreatif is not only a local economic solution but also an iconic sustainable architecture model in rural areas of North Sumatra, Indonesia.

Kata Kunci: Arsitektur berkelanjutan, energi terbarukan, UMKM.

Abstrak

Sektor Usaha Mikro, Kecil, dan Menengah (UMKM) memegang peranan penting perekonomian Indonesia, namun sering terkendala oleh akses energi yang tidak berkelanjutan dan biaya operasional tinggi. Desa Tembung di Kabupaten Deli Serdang memiliki potensi sumber daya lokal seperti energi surya, energi kinetik dan biomassa yang belum dimanfaatkan secara optimal. Penelitian ini menerapkan pendekatan renewable energy dalam perancangan pusat UMKM (Nusantara Energi Kreatif) untuk memberdayakan masyarakat sekaligus mengintegrasikan teknologi, keberlanjutan, dan nilai-nilai komunitas secara harmonis. Desain mengintegrasikan sistem panel surya, paving tiles (energi

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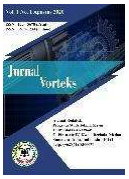

kinetik), dan biomassa sebagai sumber energi utama, desain pasif (pencahayaan alami), material ramah lingkungan (kayu Albasia, kaca low-E), serta pengelolaan air hujan dan limbah terpadu. Konsep ruang fleksibel (co-working space, pelatihan, pameran) dirancang untuk mendorong kolaborasi dan inovasi UMKM. Nusantara Energi Kreatif tidak hanya menjadi solusi ekonomi lokal tetapi juga model arsitektur berkelanjutan yang ikonik di daerah pedesaan Sumatera Utara, Indonesia.

INTRODUCTION

According to the National Statistics Agency (BPS), Micro, Small, and Medium Enterprises (MSMEs) are experiencing a positive trend and their numbers continue to increase every year. This trend will have a positive impact on the Indonesian economy, particularly in Deli Serdang Regency. The economy of Deli Serdang Regency grew by 5.36 percent in 2024. Growth occurred in almost all business sectors.[1] The business sector that experienced the highest growth was Accommodation and Food Services, at 15.06 percent, indicating that MSMEs in Deli Serdang Regency have great potential for growth and can make an even greater contribution to Indonesia.[2]

However, due to the vulnerability of this industry, environmental changes have a significant impact on the sustainability of MSMEs. Not only MSMEs, but all businesses are currently facing difficulties and must find ways to adapt to a different competitive environment. The main challenge for MSMEs to be able to develop further is access to efficient and sustainable energy. The development of renewable energy is an important solution in overcoming the energy crisis and environmental impact in Indonesia. Tembung Village, Percut Sei Tuan Subdistrict, Deli Serdang Regency, has abundant natural resources such as sunlight, biomass, and wind, but these have not been utilized optimally.

Literature Review

1. Nusantara Energi Kreatif

The local community still relies on conventional energy sources, which are not only expensive but also have a negative impact on the environment. Therefore, the combination of the words "Nusantara" was chosen to represent national and local identity, the word 'Energy' describes a design based on renewable energy, and the word "Creative" was chosen to represent the community's innovation to continue to develop and be sustainable.[3]

Nusantara Energi Kreatif with a Renewable Energy Approach aims to explore the potential of renewable energy in Tembung Village to create local energy independence. This approach not only encourages the use of green technology, but also empowers the community through training and environmentally friendly energy innovations. Thus, it is hoped that a sustainable energy management model can be created that is capable of improving the village economy while reducing carbon emission.[4]

2. Renewable Energy Architecture

Renewable energy is energy generated from natural sources such as the sun, wind, and water, and can be produced again and again. The sources will always be available and do not harm the environment.[5] Renewable Energy Architecture refers to the design of creative Nusantara energy that integrates renewable energy technologies to achieve energy efficiency, environmental sustainability, and carbon emission reduction.[6]

The Percut Sei Tuan subdistrict, particularly in Tembung Village, has great potential for developing Nusantara Energi Kreatif based on renewable energy. With local resources such as: Solar Energy: Many buildings in Tembung Village can be equipped with solar panels to meet daily electricity needs. High rainfall and Education and Training: Providing training to

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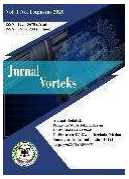

MSME players on how to utilize renewable energy and environmentally friendly business practices will increase their awareness and skills.

3. Application of Renewable Energy Architecture Principles

The following are the results of the hypothesis that will be applied to the principles of Nusantara Energi Kreatif buildings.

- Energy Efficiency
  - ✓ Using passive design to reduce energy consumption, such as cross ventilation, natural lighting, and thermal insulation.
  - ✓ Utilizing energy-saving technologies, such as LED lights and automatic sensors.
- Renewable Energy Use
  - ✓ Integrating solar panels on the roof and facade of the building to generate electricity from solar energy.
  - ✓ Using local biomass (such as organic waste from SMEs) as an additional energy source.
- Resource Recycling
  - ✓ Managing rainwater for irrigation or toilet use.
  - ✓ Utilizing recyclable building materials or those sourced from local materials.
- Environmentally Friendly
  - ✓ Using low-carbon construction materials, such as recyclable wood from albasia trees.
  - ✓ Creating green spaces around buildings to improve air quality.
- Education and Socialization.
  - ✓ Providing demonstration or training areas related to renewable energy for the local community.

METHODOLOGY

Methodology is a systematic critical study of the principles, procedures, and practices that form a discipline or field of application. It is the science of methods that answers the question of why a method is chosen, not just how to do it. Based on the type of data and approach used, this final project employs the following research methods:

1. Data Collection

This study uses primary and secondary methods. Primary data is data collected directly from sources for research purposes in accordance with the required data objects. The data collected consists of information regarding observation results, surveys, and documentation. Secondary data used includes previous research references, books, scientific journals, and articles. The secondary data required is information related to the design.

2. Data Analysis

Data analysis is conducted through direct observation or field visits, surveys, documentation, and literature reviews. This data can be used as a reference when planning Nusantara Creative Energy.

SUMMARY AND DISCUSSION

1. Site Analysis

Figure 1 Site.

Location: Jl. Kapten Batu Sihombing, Kenangan Baru, Tembung, Kec. Percut Sei Tuan, Kab. Deli Serdang, Sumatera Utara 20371.
Total area: ± 352.000 m2.
Realized area: ± 25.000 m2.

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2. Orientation Analysis

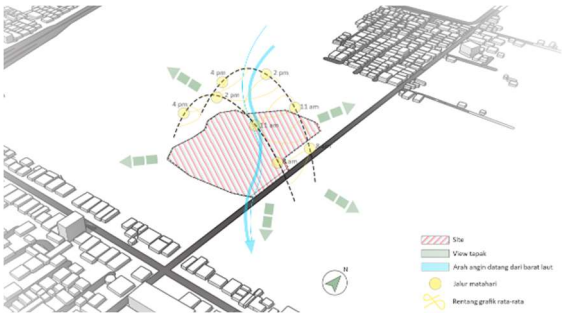

Figure 2 Orientation analysis.

The view extends around the site where the albasia trees are located. The wind comes from the northwest and can change over time.

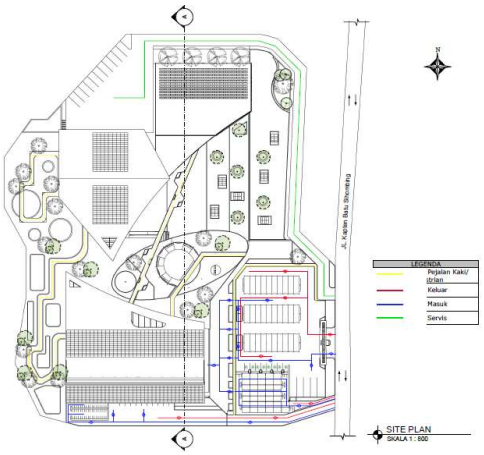

Figure 3 Siteplan.

This circulation applies inclusive circulation designed to explore all areas desired by visitors.

3. form Analysis

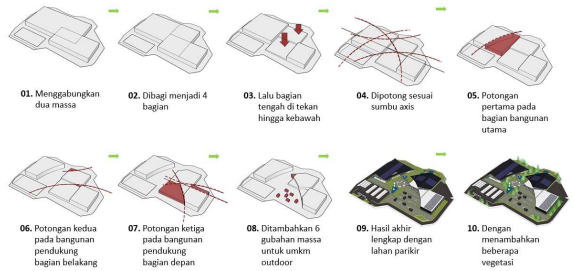

Figure 4 Transformation of form

The shape of the Nusantara Energi Kreatif building was designed based on the concept of the axis of the surrounding environment, so that it is more natural and adaptable, and also follows the direction of the wind around the site.

4. Building Concept

Figure 5 Main building.

Nusantara Energi Kreatif reflects a center for small and medium enterprises that combines local wisdom, renewable energy utilization, and creative innovation to empower the community of Tembung Village. The building also has a futuristic feel while remaining rooted in

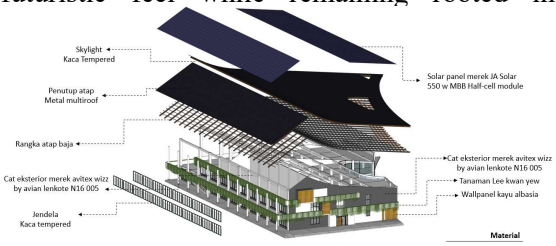

Figure 6 Use of renewable energy materials and technologies.

The use of renewable energy can be applied in the use of materials and technology in buildings.

5. Use of Renewable Energy Technology

Figure 7 Solar panels, rainwater retention, and kinetic energy sky bridges.

- The solar panels used are JA Solar 550 w MBB Half-cell modules, which are intended to supply electricity to the building.

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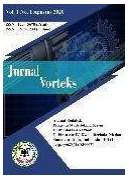


- Rainwater retention, intended for flushing toilets, watering surrounding plants, or washing vehicles.
- Sky bridge as a means of connecting the main building and the supporting building, intended to supply electricity to the outdoor SME building.

Table 1 Scheme for the use of renewable energy waste residues

Renewable Energy System	Types of Waste	Processing Technology	Recycling Results
Solar Panel	Modul photovoltaic/crash	Mechanical recycle	• Glass and aluminum for new construction materials or home decorations • Copper scraps for the electronics industry or craft products.
Rainwater Retention	Mud and sendimentation	biofiltration	• Clean water for watering plants and toilets/flushing
Sky Bridge Cinetic Energy	Broken paving	Crushing & recasting	New floor construction material with mosaic modification

6. Implementation of Utility Systems

The implementation of utility systems based on renewable energy sources such as solar, biomass, kinetic energy, and rainwater harvesting can be an effective and sustainable solution that leverages local potential and meets the needs of MSMEs. Rainwater harvesting and bioretention drainage systems can address flooding issues while also providing water for irrigation or sanitation.

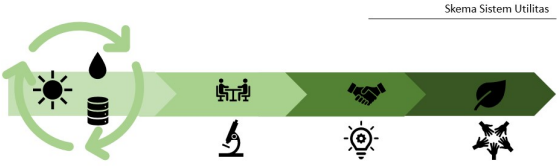
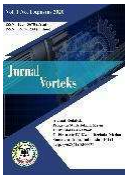


Figure 8 Scheme of utility sistems

However, the success of this integration depends on factors such as ease of maintenance, affordable initial costs, and training for the community. For example, piezoelectric technology (kinetic energy) may require public awareness campaigns to facilitate its adoption. A phased and participatory approach involving SMEs in the planning process will ensure that this system is not only environmentally friendly but also enhances productivity and the economic value of the SME hub. Thus, this building will not only serve as a symbol of sustainability but also as a tangible driver of the green economy for the residents of Tembung Village.[8]

CONCLUSION

Based on the results of the research conducted, it can be concluded that the Nusantara Creative Energy Design in Tembung Village implements a sustainable energy transition model that integrates technical, social, and economic aspects in a comprehensive manner. Through the application of energy efficiency, the utilization of renewable sources, and flexible design, this design not only reduces dependence on fossil fuels but also creates buildings that are adaptive to the tropical climate. The key to success lies in community-based energy buildings that ensure transparency, equitable distribution of



economic benefits, and the creation of local job opportunities, as well as community involvement in planning, which strengthens long-term sustainability.

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