



# A Battery-Powered Tram ready to Operate in Bali; an Answer to Green Energy Public Transportation

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## ABSTRACT

In 1945, Indonesia achieved its Independence from Japan. However, starting from 1945 until 2019, the development of the railway system in Indonesia has stagnated. In early 2020, PT KAI announced a new project through their official Instagram account @Keretaapikita. It would be a collaboration project between the KAI, the Central Government and Regional Governments to plan and discuss the development of rail-based urban mass transportation in several big cities in Indonesia, including Bali. It was a part of the Government's strategy to equalize area development throughout Bali and manifest accessible transportation. Including the supporting plan for North Bali Airport and mass transportation establishment. Over the years, a recent study revealed that the community interest in public transportation had plummeted drastically. However, it was shown that the community showed a strong perception in supporting the development of alternative modes of train/LRT/ART to all districts in Bali. Furthermore, the battery-based electric tram in Bali is scheduled to start its construction in March 2022. The completion would depend on the result of the feasibility study.

**Keywords:** Bali, Train, Tram, Public Transportation.

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## INTRODUCTION

In the Dutch colonialism period between 1879-1882, Indonesian railways were well developed. The Dutch East Indies Company concentrated on its railway development since the machine was the fastest transportation; thus, it played a crucial role. History recorded that August 10, 1867, was the first inauguration of the Indonesian railway. The first railways were meant to connect Semarang – Tangoeng, with 25 km total in the distance. The historical event placed Indonesia (Dutch East Indies) as the second Asian country to have a railway system after India. The history described that the Indonesian railway (Dutch East Indies) was one of the most advanced in the world in its heyday.

Further, an electric signaling system was installed in Medan in 1924. Then, an electric train network was built across Batavia in 1925. The fastest train was recorded in 1929 by the SS 1000 class locomotive. Its speed reached fantastically at 120 km/h.<sup>1</sup> In 1945, Indonesia achieved its Independence from Japan. However, starting from 1945 until 2019, the development of the railway system in

Indonesia has stagnated. In fact, of the five major islands in Indonesia: Sumatra, Java, Kalimantan, Sulawesi and Papua, railway infrastructure had only concentrated on Java.<sup>2</sup>

Entering 2020, the Government set a new goal for Train development in Indonesia. After several projects such as Jakarta MRT, Speed Train to connect Surabaya, Jakarta and Bandung, PT KAI, through its official Instagram account @Keretaapikita, stated that KAI, together with the Central Government and Regional Governments, were planning and discussing the development of rail-based urban mass transportation in several big cities in Indonesia. One of the programs was Autonomous Rail Rapid Transit (ART). ART was one of the latest train technology. It was introduced and tested by CRRC Zhuzhou China on May 8, 2018. ART runs on highways with specially marked lanes. ART design resembles a tram but uses rubber wheels and is fueled by electrical power. On May 18, 2018, the Directors of PT KAI had the opportunity to test ART.

The plan to build a railless train

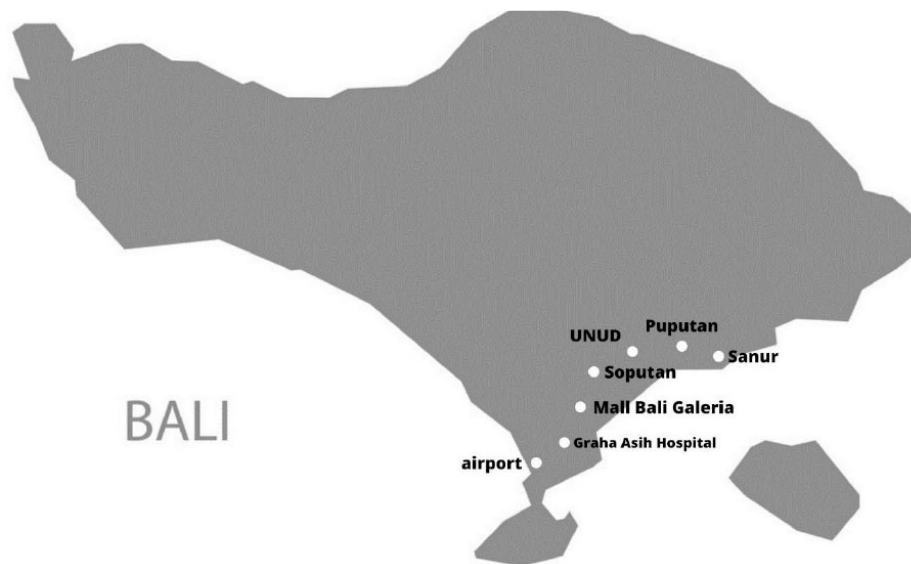
in Indonesia would be developed in Indonesia, with Bali as its first pilot area. After the company visit, it was then decided there would be a collaboration between KAI and CRRC Zhuzhou China to develop the operation of the ART Tram in Indonesia. It was legally written through the signing of the MoU between KAI and CRRC TEC on May 18, 2018. On March 9, 2020, the legal study of ART carried out by Pustrat UGM was completed. Then, the results were presented to DJKA, Ministry of Transportation, on May 7, 2020. In its upcoming schedule, PT KAI would bring the Chinese-tech ART to be operated in Bali.

## An answer to Green Energy Public Transportation

PT. Industri Kereta Api (Persero) tested a prototype of a battery-powered tram developed for the last few years by Chinese-based train manufacture. It was an answer to the challenges of an environmentally friendly and comfortable mode of transportation demand. President Director of PT INKA (Persero) Budi Noviantoro in Madiun, East Java, explained



**Figure 1.**<sup>3</sup> 1864 – The first railway establishment in Java, Inaugurated by Dutch Governor-General Sloet van de Beele.



**Figure 2.**<sup>4</sup> The ART would connect Ngurah Rai International Airport to the Sanur area. The approximate routes would be (1) Airport Station, (2) Bali Mandara Station, (3) Graha Asih Hospital Station, (4) Bali Galeria Station, (5) TOD Check-In AP1, (6) TOD Centra Parking Siloam Station, (7) TSM station, (8) Soputan Station, (9) Intermodal Station, (10) RSKI Station, (11) Tantular Station/21, (12) Unud Station, (13) Puputan Field Station, (14) Renon Station and (15) Sanur Station.

the test was to show the “performance” of battery trams before continuing for mass production. The tram trial was round trip travel from Madiun Station to Babadan. The trial began on Monday (9/11/2021) until Tuesday (10/11/2021). It was an initial trial of the battery tram prototype to be tested outside INKA’s track.

The tram consists of two carriages;

One has a propulsion unit equipped with a battery, and the other is the passenger carriage. It is equipped with a seat for passengers and a handrail at the top for standing passengers. Trams utilize batteries as their sole source of energy. The battery energy then powers the train, the air conditioners, compressors, and the train lighting system. The latest prototype

has a battery capacity of 30 KWh with a charging time of 3 to 4 hours. The distance traveled on a single battery charge reaches 25 kilometers. Budi added that later the tram would be offered to the domestic and foreign markets. So far, INKA has collaborated with the Bali Provincial Government for mass production.<sup>4</sup>

Meanwhile, President Director of PT KAI Didiek Hartantyo explained that ART would connect Ngurah Rai International Airport to the Sanur area. The approximate routes would be: (1) Airport Station, (2) Bali Mandara Station, (3) Graha Asih Hospital Station, (4) Bali Galeria Station, (5) TOD Check-In AP1, (6) TOD Centra Parking Siloam Station, (7) TSM station, (8) Soputan Station, (9) Intermodal Station, (10) RSKI Station, (11) Tantular Station/21, (12) Unud Station, (13) Puputan Field Station, (14) Renon Station and (15) Sanur Station.<sup>3</sup>

PT INKA (Persero) and Perusda Bali agreed to build an electric-powered urban transportation facility. President Director of PT INKA (Persero) Budi Noviantoro said the agreement had been written in the signing of a memorandum of understanding (MoU) between INKA and Perusda Bali regarding the project on Thursday (22/10/2020). Noviantoro said PT INKA and Perusda Bali would later develop a battery-based urban transportation system, such as electric trams and electric buses. In the future, he continued, PT INKA (Persero) and Perusda Bali will also establish a joint venture company to develop and operate the transportation system. According to him, the cooperation was also for developing an integrating transportation system based on electric vehicles. The collaboration project would connect tourist destinations, including the Kuta, Sanur, Ubud, and the Bali Gunaksa Cultural Center Areas.<sup>5</sup>

In addition, the two companies would develop the commitment to maintain the facilities and establish the infrastructure of trains and battery-based electric motor vehicles in the future. Budi added that in terms of funding, PT INKA (Persero) would be supported by the Islamic Development Bank (IsDB) based in Jeddah, Saudi Arabia. The agreement signing was attended by PT INKA





**Figure 3.**<sup>10</sup> The first look of Autonomous Rail Rapid Transit (ART).

President Director Budi Noviantoro and Operation Team Leader Islamic Development Bank (IsDB) Regional Hub Indonesia Omar Eddie Davis. Also attending online from the Province of Bali was the President Director of Perusda Bali Nyoman Kami Artana and the Head of the Bali Provincial Transportation Service I Gede Wayan Samsi Gunarta.<sup>6</sup>

### A Grand Project of Future Cities

Plans for rail-based mass public transportation construction, efforts to build North Bali Airport and Railway Traces, and the concept of the TOD area are the efforts to equalize development and movement in the Bali Province Region. Besides Bali, electric trains would be constructed in the new Indonesian capital in the Kalimantan region. Minister of Transportation Budi Karya Sumadi said the development of the State Capital (IKN) was planned as an innovative, smart, and sustainable capital city, so it required to be well prepared. Including systems, networks, and modes of public transportation must be environmentally friendly and sustainable. To achieve the IKN development goal, according to Budi, President Joko Widodo (Jokowi) will invite investors from Japan and Britain. Both countries have experience in capital city development. Thus, it is expected that the IKN development will be successful according to the grand plan. He ensured

that IKN would implement a sustainable electricity-based transportation system. For instance, the electric rail train (KRL) from Balikpapan to IKN. Furthermore, the Ministry of Transportation would also initiate electric buses, trams, and other modes, including individual cars. At IKN, the source of electrical energy would not be a problem since Kalimantan is abundant in coal stock and equipped with water and solar power plants.<sup>7</sup>

Indicators of Accessibility, Mobility, and Connectivity are indicators of the success of an integrated transportation infrastructure development. The meaning of integration, according to May, Kelly and Shepherd (2006), is the integration between the policies of each mode, the integration between policies related to the development of facilities and infrastructure, management, information and tickets, the integration between transportation and land use, and integration with the area. Other policies such as health and education. Integration of the development of facilities and infrastructure, especially for the public transportation service network.<sup>8</sup>

The development of public transportation modes is the Government's effort to unravel congestion amid the growth of the tourism industry on the island of the gods. However, a study states that public transportation users in Bali tend to decrease. The Public Transport Study

survey (2005) showed only 5% of public transportation users, and the figure was expected to continue to decline. The use of land public transportation is estimated to be less than 1%. Land transportation was significantly dominated by private transportation, especially motorbikes and cars. In Bali, there was an imbalance growth between motorized vehicles at 5.396% per year and road infrastructure at 0.01% per year.<sup>9</sup> The phenomenon resulted in causing problems with traffic congestion and air pollution. In addition, it impacted community losses such as decreasing levels of air quality, long travel times, and increased vehicle operating costs.

### Communities Approval

An increasing number of motorized vehicles described Bali's transportation condition: It increased by an average of 6.41% per year in the last five years. In specific figures, motorized vehicles ownership has increased by an average of 218,495 units per year or 599 units per day, while the increase in road infrastructure is on average of 1.83% per year-it indicating a significant imbalance between the provision of road infrastructure and the growth rate of vehicle ownership. The level of motorization in Bali is also relatively high, namely 1.45 and 1.29 in Denpasar and Badung. The trip's profile that people in Bali often do is trips to work, the travel destination with the most significant proportion, namely 37.92%, followed by trips to school by 27.92%, recreation by 20.83% and other social trips by 13.33%.

Although public interest in the use of public transportation has decreased, another fact states that the community gives a perception of agreeing and strongly agreeing more than 83.56% for the development of alternative modes of train/LRT/ART to all districts in Bali. While those who disagreed only amounted to 8%. The majority of the community, 89.33%, agreed that there was an alternative mode of ferry transportation from Denpasar to all regencies in Bali. The mode was developed by utilizing ferry ports such as Benoa, Sanur, Jimbaran, Kedonganan, which local people and tourists can use for transportation to the intended mall, café or restaurant.<sup>11</sup>

The construction of a battery-based

electric tram in Bali is planned to begin in March 2022, with the completion target still adjusting to the feasibility study currently being carried out. The plan to build urban transportation facilities in battery-based electric trams was a follow-up action after a memorandum of understanding between PT Industri Kereta Api (Persero) and PT Perusahaan Daerah (Perusda) Bali had signed on October 22, 2020. Up to the moment, the project is predicted to support energy development. Environmentally friendly in Bali is still in the feasibility study stage. Senior Manager of the Business Development Department of PT INKA (Persero) Apoleus Karo Karo said, if realized, this project would support the Bali Governor's regulation 48/2019 regarding the use of battery-based electric motorized vehicles.

The feasibility study examines the distance from the tram until the target is completed. The development of this electric vehicle-based transportation system is planned to cover the areas of Kuta, Sanur, Ubud and the Bali Gunaksa Cultural Center Area. "This battery tram uses a battery component that also supports the Government's plan to build a domestic battery factory. However, it is currently still outside because there is not yet one," he told Bisnis, Monday (15/2/2021). Previously, Perusda Bali Business Development Director Bagus Gde Ananta Wijaya Karna said the feasibility study is targeted to be completed in September 2021. The two companies will conduct a feasibility study and discuss business schemes and the licensing process throughout this year. The exact point of the construction of the battery-based electric tram is still under the study results.<sup>12</sup>

## CONCLUSION

In early 2020, PT KAI announced a new project through their official Instagram account @Keretaapikita. It would be a collaboration project between the KAI, the Central Government and Regional Governments to plan and discuss the development of rail-based urban mass transportation in several big cities in Indonesia, including Bali. It was a part of the Government's strategy to equalize area development throughout Bali and manifest accessible transportation. Including the supporting plan for North Bali Airport and mass transportation establishment. Over the years, a recent study revealed that the community interest in public transportation had plummeted drastically. However, it was shown that the community showed a strong perception in supporting the development of alternative modes of train/LRT/ART to all districts in Bali. Furthermore, The battery-based electric tram in Bali is scheduled to start its construction in March 2022. The completion would depend on the result of the feasibility study.

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