## **REPORT OF RESEARCH RESULTS**

Title Improving traffic safety of vulnerable users and energy efficiency with 'glow in the dark' road markings

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**Summary** In Thailand, road traffic accidents are a major public health concern, with the country ranking 1st in ASEAN and 9th globally in road traffic death rates. The annual economic loss due to road accidents is estimated at 6% of Thailand's GDP. Infrastructure design and improvement, particularly in road markings, are identified as critical areas for reducing road fatalities. This project aims to address the safety challenges associated with poor nighttime visibility on rural roads by introducing an innovative solution: WU Glow-in-the-Dark (WU-GiD) road markings. GiD materials, or luminance materials, could store energy from external light sources and emit visible light in the absence of light, thereby enhancing road visibility during nighttime. This property is particularly beneficial for rural areas in developing countries like Thailand, where electricity for street lighting is scarce and expensive. The project explores the use of GiD materials in road markings as a low-cost, energy-efficient solution to improve traffic safety.

The novelty of this project lies in the development and application of durable GiD road reflectors suitable for Thailand's harsh environmental conditions. Unlike conventional GiD paints, which suffer from drain-down effects and limited glow duration, the newly developed GiD road reflectors are designed to provide long-lasting luminance, with a glow duration of up to 10 hours. This innovation not only enhances the visibility of road markings but also reduces the need for electrical lighting, contributing to energy savings. In terms of cost, the initial material cost of GiD road reflectors is higher than by 3-5% that of conventional road reflectors available in the market. However, the long-term benefits of reduced maintenance, energy savings, and improved safety justify the investment. By reducing the frequency of road accidents and associated costs, the GiD road reflectors offer a cost-effective solution for enhancing road safety in rural Thailand.

In summary, the introduction of GiD road markings presents a novel and sustainable approach to improving nighttime road safety and energy efficiency in Thailand's rural areas. This project has the potential to significantly reduce road traffic accidents, save lives, and contribute to the country's economic sustainability by addressing a critical infrastructure challenge.

Aim of Research This study aims to develop efficient, life-saving low-cost road stud solutions for enhanced road safety in rural Thailand.

Method of Research & Progression To achieve the above Objectives, low-cost locally made GiD road stud prototypes were be produced and compared with GiD paint coated with transparent epoxy. The two GiD solutions demonstrated in a road section within Walailak University campus which has been identified as unsafe due to the presence of sharp bends and no night lighting. The GiD stud prototype was tailored to glow for 8 hrs after light excitation, thus avoiding the need for on-site power. Field performance testing including rut testing and load bearing were performed on the developed GiD solutions to study their performance in practical road applications. The experimental program includes two Work Packages on laboratory work (WPs 1-2), one WP on demonstrations (WP3), and one WP on Dissemination and Technological Transfer (WP4). Duration and junior staff involved in the WPs were also identified. The following activities were carried out:

- WP1: Material Development
- WP2: Performance testing on stud prototype
- WP3: Full-scale Demonstration & Monitoring
- WP4: Dissemination and technological transfer

# Results of Research

## 1). Development of GiD Road Reflectors:

The research team successfully developed durable WU-GiD road reflectors, designed to withstand harsh environmental conditions in Thailand. These

reflectors utilize advanced luminance materials capable of storing energy from daylight and emitting visible light for up to 10 hours during nighttime. formulation The innovative ensures a longer glow duration durability and greater compared to conventional GiD paints.



#### 2). Performance Evaluation:

Field tests at Walailak University were conducted on rural roads to evaluate the performance of the GiD road reflectors. The results showed a significant improvement in nighttime visibility, with the luminance of the road markings clearly visible to drivers from a distance of over 150 meters. The reflectors maintained their glowing properties throughout the test period, demonstrating their resilience to weathering and wear.



#### 3). Energy Efficiency:

The implementation of GiD road markings reduced the reliance on electrical

lighting for road illumination. This contributes to energy savings and aligns with the global efforts to reduce carbon emissions. The research estimated that the use of GiD road markings could potentially save up to energy 50% of the consumed by conventional street lighting in rural areas.



## 4). Cost-Effectiveness:

A comparative analysis of the material costs revealed that while the initial investment in GiD road reflectors is higher than conventional reflectors, the long-term benefits outweigh the initial costs. The reduced need for maintenance, energy savings, and the extended lifespan of the GiD reflectors contribute to their cost-effectiveness. Furthermore, the potential reduction in road accidents and associated costs further justifies the investment in this innovative road safety solution.

## 5). Safety Impact:

The introduction of GiD road markings has the potential to significantly enhance road safety in rural Thailand. By improving visibility at night, the risk of accidents is reduced, leading to fewer injuries and fatalities. The research project aligns with Thailand's national strategy to reduce road traffic deaths and improve public health outcomes.

In conclusion, the research project on Glow-in-the-Dark road markings has demonstrated promising results in terms of improving nighttime visibility, energy efficiency, and cost-effectiveness. The successful development and application of durable WU-GiD road reflectors represent a significant innovation in road safety infrastructure, with the potential to make a meaningful impact on reducing road traffic accidents in rural Thailand.

**Future work** The future work will focus on scaling up the implementation of Glow-in-the-Dark (WU-GiD) road markings to cover a wider network of rural roads in Thailand. Efforts will be made to further optimize the formulation of the GiD materials to enhance their durability and luminance. Additionally, collaborations with local authorities and communities will be sought to ensure the widespread adoption and maintenance of the GiD road markings. Research will also be conducted to assess the long-term impact of these road markings on road safety statistics and energy consumption in rural areas.

Means of Official Announcement of Research Results

"Improving Traffic Safety and Energy Efficiency with 'Glow in the Dark' Road Markings" will be strategically disseminated to reach a wide audience and maximize impact. The novel findings, including the development of durable Walailak University Glow-in-the-Dark (WU-GiD) road reflectors and their performance evaluation, will be published in esteemed civil engineering and transportation safety journals and already won the gold medal in the Arau International Creativity Exhibition 2023 (Fig. 1). This academic outreach ensure engagement with the research community and industry experts. Furthermore, partnerships with government agencies and industry stakeholders will be forged to communicate the project's qualitative and quantitative benefits, such as enhanced nighttime visibility, energy savings, and potential reductions in road accidents. Workshops and presentations will be organized to demonstrate the project's outputs and advocate for the adoption of this innovative road safety solution. To raise public awareness, the research team will collaborate with media outlets for coverage in news articles, television segments, and social media platforms, highlighting the novelty and effectiveness of the WU-GiD road markings. Additionally, comprehensive technical reports and policy briefs will be prepared and shared with policymakers and stakeholders, promoting the integration of WU-GiD road markings into national road safety and infrastructure development plans. Through these multifaceted means of official announcement, the research team aims to promote the adoption of Glow-in-the-Dark Road markings as a practical solution for improving road safety and energy efficiency in rural Thailand.



Fig. 1 Graphical abstract of the project (Gold medal in the Arau International Creativity Exhibition 2023, University Malaysia Perlis).