

**LIFE CYCLE ASSESSMENT OF COMPRESSED BIOMETHANE GAS
AS SECOND GENERATION BIOFUEL IN THAILAND**

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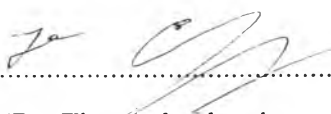
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ABSTRACT

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Keywords: Life cycle assessment (LCA)/ Compressed biomethane gas (CBG)/ Net energy ratio (NER)/ Global warming potential (GWP)

This study aims to conduct life cycle assessment (LCA) of compressed biomethane gas (CBG) in terms of both energy and environmental aspects. The system boundary was set to cover all processes throughout the entire life cycle of CBG including provision of feedstocks (pig manure and napier grass), biogas production, upgrading, compression, transportation, and operation in a vehicle (combustion). This is called a well-to-wheel (WTW) analysis. Required data for the analysis were extracted from literature and were also collected at an actual CBG plant in Thailand (Mae Taeng, Chiangmai). The data were analyzed by using commercial LCA software, SimaPro 7.1, based on functional units of 1 MJ of CBG. The resulting CBG from the processes was evaluated in terms of global warming potential (GWP) and net energy ratio (NER). The results were also compared with those of conventional fuels (CNG and gasohol 95). The energy analysis results showed that the NER of CBG was higher than one, implying a net energy gain for this CBG system. For the environmental aspect, the results indicated that the biogas production process had the highest GWP impact resulting from high methane loss and the energy consumption. Compared with conventional fuels, the GWP of CBG was higher than these of fossil-based CNG and gasohol 95 for the well-to-tank (WTT) phase. On the contrary, the comparative result of GWP in tank-to-wheel (TTW) phase was reversed. When combining WTT and TTW, the GWP of CBG in WTW phase was shown to be better than these of the conventional fuels.

บทคัดย่อ

ภาณุพงศ์ พรหมชานา : การประเมินตลอดวัฏจักรชีวิตของแก๊สไบโอมีเทนอัดซึ่งเป็นเชื้อเพลิงชีวภาพรุ่นที่สองในประเทศไทย (Life Cycle Assessment of Compressed Biomethane Gas As Second Generation Biofuel in Thailand) อ. ที่ปรึกษา: ผศ. ดร. ปมทอง มาลากุล ณ อยุธยา และ ดร. ธวัช ฉัตรชูพงศ์, 93 หน้า

งานวิจัยนี้ทำการประเมินตลอดวัฏจักรชีวิตของการผลิตเชื้อเพลิงชีวภาพแก๊สไบโอมีเทนอัด ทั้งในด้านพลังงานและด้านสิ่งแวดล้อม ขอบเขตของการศึกษานี้ครอบคลุมตลอดวัฏจักรของแก๊สไบโอมีเทนอัด ตั้งแต่การได้มาซึ่งวัตถุดิบ ซึ่งได้แก่มูลสุกรและหญ้าเนเปียร์ การผลิตแก๊สชีวภาพ การปรับปรุงคุณภาพแก๊สชีวภาพ การอัดความดัน การขนส่ง ตลอดจนการเผาไหม้ในเครื่องยนต์ เรียกว่าเป็นการวิเคราะห์แบบ well-to-wheel การศึกษานี้มีการใช้ข้อมูลทุติยภูมิรวมทั้งได้รวบรวมข้อมูลจากโรงงานผลิตแก๊สไบโอมีเทนอัดในประเทศ ที่อำเภอแม่แตง จังหวัดเชียงใหม่ อีกด้วย ข้อมูลต่างๆ ที่รวบรวมได้นั้นถูกนำมาวิเคราะห์โดยใช้โปรแกรมประเมินตลอดวัฏจักรชีวิต SimaPro 7.1 หน่วยการทำงานที่ใช้คือ 1 เมกะจูลของแก๊สไบโอมีเทนอัด จากนั้นทำการประเมินภาระด้านสิ่งแวดล้อมในแง่ของผลกระทบต่อภาวะโลกร้อนและภาระด้านพลังงาน และมีการเปรียบเทียบผลการประเมินที่ได้กับเชื้อเพลิงพื้นฐาน ได้แก่ แก๊สธรรมชาติอัดและน้ำมันแก๊สโซฮอล์ 95 จากผลการศึกษาพบว่า ค่าสัดส่วนพลังงานสุทธิของการผลิตแก๊สไบโอมีเทนอัดนั้นมีค่าสูงกว่าหนึ่ง แสดงให้เห็นว่ามีการได้เปรียบเชิงพลังงาน ส่วนในด้านสิ่งแวดล้อม พบว่าขั้นตอนการผลิตแก๊สชีวภาพเป็นขั้นตอนที่ส่งผลกระทบต่อภาวะโลกร้อนสูงที่สุดเนื่องมาจากการใช้พลังงานและมีการสูญเสียมีเทนออกจากระบบสูง เมื่อเปรียบเทียบผลการทดลองกับเชื้อเพลิงพื้นฐาน พบว่าในส่วนของ well-to-tank นั้น ศักยภาพที่ทำให้เกิดภาวะโลกร้อนของแก๊สไบโอมีเทนอัดมีค่าสูงกว่าของแก๊สธรรมชาติอัดและน้ำมันแก๊สโซฮอล์ 95 แต่สำหรับในส่วน of tank-to-wheel พบว่าศักยภาพที่ทำให้เกิดภาวะโลกร้อนของแก๊สไบโอมีเทนมีค่าต่ำกว่าของแก๊สธรรมชาติอัดและน้ำมันแก๊สโซฮอล์ 95 และเมื่อรวมเข้าเป็นการประเมินแบบ well-to-wheel พบว่าแก๊สไบโอมีเทนอัดส่งผลกระทบต่อภาวะโลกร้อนต่ำกว่าเชื้อเพลิงพื้นฐานทั้งสองชนิด

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