Greening a Campus-led Economy Through a Low-Carbon Transport: The case of Prince of Songkhla University

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ABSTRACT

DESCRIPTION

Green development projects aimed at greening campus economies through sustainable consumption and production (SPC), are significant when considering various forms of on-campus transportation systems such as alternative energy research and practice, environmental and resource conservation, and waste management. Such initiatives include the communication and collaboration among university researchers and a variety of stakeholders and potential partners, including industries, communities and government sectors. This learning case revolves on the development and planning of an electric vehicle (EV) bus programme for on-campus and neighbouring community transport. The working sessions following the learning case serve to inspire discussions on green growth promotion for universities and other organisations.

Learning objectives:

To appreciate the broad concept of green growth promotion.
To better realize the contribution of the EV programme.
To understand the link between EVs and reduction of CO_2 emissions.
To scrutinize the challenges regarding implementation of an EV transportation system.

Subjects covered:

Biodiesel; Electric vehicles (EVs); Green growth promotion; Sustainable development

Setting:

- Prince of Songkhla University, Had Yai District, Songkhla Province
- Had Yai city municipality
- Khohong municipality (in Had Yai city)

INTRODUCTION

In the year 2000, the Faculty of Environmental Management at Prince Songkhla University (PSU) launched its first environmental policy with more than 20 university administrators and researchers officially trained in how to implement environmental management systems which meet international standards. Similarly, the Faculty of Natural Resources, Faculty of Engineering and Faculty of Agro-industry carried out alternative energy research trying to produce biodiesel from oil-palm in an attempt to realize the national initiatives on sustainable energy. The university's biodiesel-led alternative energy project has generated a greener economy involving nearby communities, industries and government sectors all sharing mutual benefit from this unique kind of sustainable production and consumption. Other alternative energy research projects, such as waste to energy and sustainable energy management were later implemented and a new research institute with two interrelated graduate programmes in Energy Engineering and Sustainable Energy Management were established. A practical outcome of the university's sustainable energy production and consumption research includes alternative campus transport. The next sections discuss the alternative campus transportation which points towards these key issues: its impact to the communities and the importance of public policies, and the development of green growth promotion and low-carbon communities.

TOWARDS A SUSTAINABLE UNIVERSITY CAMPUS

Through years of experimentation, PSU, which is located in a highly urbanized municipality area and next to an increasingly populated Khohong municipality (see Figure 1-3), has encouraged the use of bicycles and campus-made biodiesel (instead of petrol) and introduced the use of biodiesel buses. Recently, the university has introduced electric buses for on-campus transport, and this is partially in response to an increasing concern of carbon dioxide in the wake of growing global outcry regarding global warming and given the issues associated with palm oil utilization. The first electric bus was first by PSU in 2009 and several others were put into operation for mass transport in 2011. Currently, seven electric buses are servicing students and staff daily and operate six days a week.

Beginning in August 2011, the EVs have been provided free of charge for students and lecturers in the Had Yai campus and the nearby Khohong community from 7:00 am to 7:00 pm, Mondays through Saturdays. Each EV is equipped with 25 seats and 15 standing places, with a sliding door for entering and exiting (see Figure 4a and 4b). The on-campus service

also extends to some key locations in the city, such as supermarkets and other areas as requested.

Figure 1.Thailand in South East Asia (http://victorylifechristianschool.com 2013)

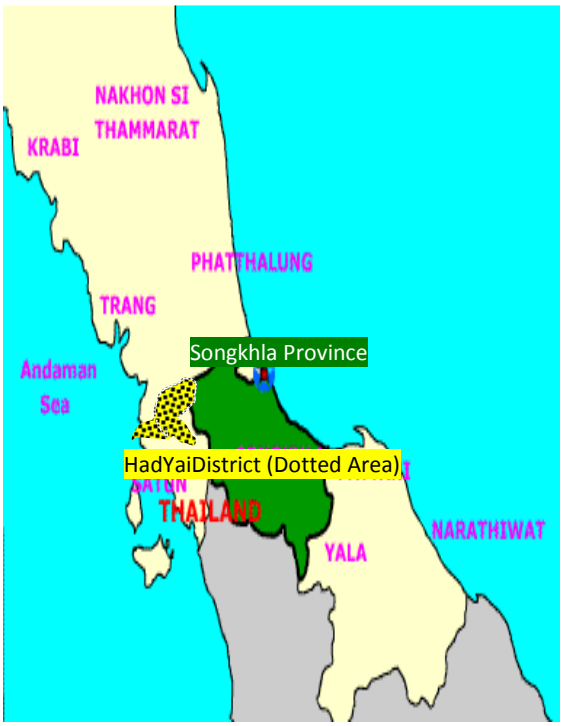

Figure 2. Had Yai District in Songkhla Province (adapted from http://jgraceg.blogspot.com 2013)

Figure 3. Had Yai city (http://en.hoteldirect.in.th 2013)

In February 2012, the university signed a memorandum of understanding (MoU) with Had Yai city municipality jointly declaring their common aspiration for green growth promotion through the reduction of CO_2 emissions. In order to demonstrate the support coming from the municipality, three EVs (see Figure 5a and 5b) costing approximately 2,250,000 baht were donated. The plan was based on enacting a mass transportation scheme within PSU Had Yai campus; it was intended to be 'free of charge' for all users. The ensuing programme was

aimed at promoting a reduction in carbon transport emissions at PSU and in Had Yai city. The programme also supports the objective of a 'zero transportation accident' plan and an overall 20% reduction of motorcycles on campus.


Figure 4a and 4b. Seats and the door of the EV (www.psu.ac.th 2013)


Figure 5a and 5b. EVs supported by Had Yai city municipality (www.psu.ac.th 2013)

ELECTRIC VEHICLES

Generally, an EV refers to any vehicle that uses electric motors for propulsion. The electric vehicle that derives its power from an on-board battery pack is a form of battery electric vehicle. There are three types of electric vehicles– those that are directly powered from an external power station, those that are powered by stored electricity originally from an external power source, and those that are powered by an on-board electrical generator, such as an internal combustion engine (a hybrid electric vehicle) or a hydrogen fuel cell. EVs differ from fossil fuel-powered vehicles in that the electricity they consume can be generated from a

wide range of sources, including fossil fuels as well as renewable sources such as tidal power, solar power, and any combination of these.

The purchase price of electric vehicles is significantly higher than conventional internal combustion engine vehicles, even after considering incentives on different categories. The primary reason is the high cost of batteries. This high purchase price is hindering the mass transition from gasoline to electric vehicles. The running cost of an EV is attributed to the maintenance of the battery pack, and its eventual replacement. Unlike a gasoline vehicle, an electric vehicle has only around 5 moving parts in its motor, as opposed to hundreds of parts in its internal combustion engine. An EV contributes to cleaner air in cities because they produce no harmful gases. The clean air benefit is usually local because, depending on the source of the electricity used to recharge the batteries, air pollutant emissions are shifted to the location of the generation plants. The amount of carbon dioxide emitted depends on the emission intensity of the power source used to charge the vehicle, the efficiency of said vehicle and the energy wasted in the charging process. For energy efficiency, internal combustion engines are relatively inefficient at converting on-board fuel energy into propulsion as most of the energy is wasted as heat. However, an EV is more efficient in converting stored energy into driving a vehicle, and do not consume energy while at rest or coasting. In addition, some of the energy lost when braking is captured and reused through regenerative braking, which captures as much as one fifth of the energy normally lost during braking.

Regarding energy performance, a fully-charged EV can serve up to 80-100 km of driving (or 20 rounds at 5-6 km per round). Battery life expectancy is estimated at approximately five years. There are no smoke emissions, smells, or carbon-dioxide from EVs, as there is no combustion involved. Currently, there are about 5,000 passengers per day in the Had Yai area using the EV system, and this has reduced the number of on-campus motorcycles significantly. The success of this alternative transportation concept has been realized and studied by Had Yai city and nearby municipalities.

ALTERNATIVE CAMPUS TRANSPORT AT PSU

PSU shares the common ambition of producing a more environmental friendly environment with other on-campus transportation systems in various Thai universities, such as in Chiangmai, Chulalongkorn, Mahidol, Thammasart, and Walailak. In each university, the EV system was designed to fit the environment based on its unique needs, policy and willingness. For example, Chulalongkorn University, located in the highly urbanized downtown area of

Bangkok, uses a hybrid system (the 'Pink Bus') powered by both electricity and diesel in order to reduce the number of cars within the university; the service offers free shuttle buses with four routes for students, professors and staff, and operates on four routes, running from Mondays to Saturdays, 7:00 am to 7:00 pm (with buses no. 1 and 2 operating exclusively on Saturdays). Mahidol University, Salaya Campus, offers the 'Salaya Tram', a free service provided for Mahidol staff and students within the campus; tram stations are distributed campus-wide. While Chiangmai University in Northern Thailand operates an electric bus system, Thammasart University in Bangkok, currently uses a diesel powered system. Walailak University, the most spacious university in Southern Thailand, operates under a Green Policy – there are bicycle paths and free natural gas vehicle tram services for transportation around the huge campus.

Unique to PSU Had Yai campus, the university has had considerable experience in biomass energy research, has pioneered the use of biodiesel in the transportation sector, and has incorporated public involvement and government support into this process. When PSU adopted two biodiesel powered buses, learning and innovation were the two key experiences, resulting from the establishment of a combined system of electricity and biodiesel buses. Given that the university has an operational biodiesel research centre, the potential and interest to further improve and develop the sustainability of biodiesel powered vehicles and hybrid campus transport is tremendous. Despite PSU's achievements in the alternative transportation system, special attention needs to be given to sustainable development issues related to palm oil-based biodiesel. Nevertheless, electric-powered buses may offer an avenue towards developing a best-practice model for PSU and other universities/organisations, and this mode of transportation is worthy of further analyses.

THE CHALLENGE AHEAD

Arguably, the alternative low-carbon campus transport led by the EV system at PSU Had Yai campus has gained regional-wide acceptance. However, operational costs continue to increase despite various reductions to the university budget. Notwithstanding, PSU established a complete green business model which includes on-campus transportation.

Comparing profit-earnings against break-even operations demands careful discussion and decision-making. For example, while most lecturers and employees in the university generally agree with the EV concept and are well aware of the benefits of an environmental friendly operation, a majority of them are against a higher service charge for the students,

public, and neighbouring communities. This predicament poses a challenge to the university and it is worth discussing this dilemma, in order to extend the path of green growth promotion through low-carbon mass transport.

Towards Future Policies

As discussed in this learning case, in realizing the contribution of the EV programme in 'green growth promotion', the university decided to obtain additional electric buses. In the long-term, mass transportation, such as the EV model, will likely become the only choice for commuters within the university, and it is estimated that the number of services, including trip frequency and the number of EVs, would be increased 'on demand' (i.e. as necessary). Considering the potential increase in operational costs, a new scheme or business plan for future operations will need to be developed, and key questions include how to prioritise the stakeholders and how to develop the necessary key action steps.

In order to convince policy makers, local administrators and the public sector to continue supporting the EV alternative, the university may need to conduct research into the 'total economic benefit' of the operation, as well as develop an appropriate business plan for the complete system.With the support of biodiesel buses, continued research and innovation, as well as policy makers and the wider community, the EV campus transport system could pave the way to a greener campus life and serve as an important driver for green growth promotion on the campus and in local communities.

Ultimately, the questions remains as to whether continued research and innovation, as well as enlightened engagement between policy makers and community leaders, can perpetuate the EV-led campus transport towards a greener campus life for students and faculty, and whether the EV system could serve as an impetus for further green growth promotion activity among local communities. Since the context of the problem is constantly changing – in the case of transportation, a key uncertainty is the increase in motorcycles and cars inside and outside of the university campus – there is no one absolute answer to the challenges ahead.

Discussion Questions

Question 1:
In the case of PSU, how might innovations, partnerships, and the role of science and technology in sustainability be apparent and applied in a pragmatic and functional way?

Question 2:
What are the plausible policy solutions, including laws, incentive schemes, and infrastructure development, in the case of Thailand?

Question 3:
What are the key implications in moving forward with EV-led campus transport, particularly in the areas of research, the development of business plans, and in estimating the total economic benefits?

The next working sessions are divided into two parts. Part I deals with the identification of stakeholders for PSU and your own organisation, and the related issues/concerns. Part II deals with the implementation of EV transportation system within your organisation.

PART I Identification of stakeholders and issues/concerns

Assume the role of the executive board of a university/organisation (in groups of 5 persons).

Working Session 1: Identification of stakeholders

1. Identify possible key stakeholders of PSU and within the neighbouring community, and potentially, their perspectives towards electric vehicles (EV), in comparison to conventional vehicles (CV). If you were to consider your own organisation, what would the situation look like?

Worksheet 1: Identification of stakeholders

Key PSU stakeholders	Comparison of perspectives towards EV and CV

Working Session 2: Sustainable Issues

Identify specific sustainability issues related to transportation for each of the economic, environmental, and social performance dimensions. Based on the identified issues, list specific interests or perspectives of each PSU stakeholder from the context of preservice, service and postservice.

Worksheet 2: Sustainable issues

Sustainability Dimensions	**Specific sustainable issues related to EV transportation**	**Specific Interest and/or Perspective of Key Project Stakeholders**			
		Company	**Community**	**Government (National)**	**Civil Society**
1. Economic Performance: creating sustainable wealth - Pre service - Service - Post service					

2. Environmental Performance: protecting environmental values and ecological integrity - Pre service - Service - Post service					
3. Social Performance: protecting and empowering people - Pre service - Service - Post service					

Working Session 3: Impact analyses

For each discussion topic in the left column, please provide short description in the right column on the expected impact resulting from implementation of PSU's EV transportation programme.

Reflect on the expected impact within your own organization, if it were to implement such a programme.

Work sheet 3: Impact analyses

Discussion Topics	**Short description of positive or negative impact from the implementation of EV transportation programme**
Air quality and pollution	
Climate change	
Global warming	
Regional/local climate regulation	
Emotion and sense of tranquility	
Noise pollution	
Safety	
Urban planning	
Biomass fuel	
Ethical values	
Natural hazards	

Recreation and ecotourism	
Waste treatment	
Others:	

PART II Implementation of EV transportation systemWorking Session 4: SWOT analysis

List the strengths, weaknesses, opportunities, and threats if the EV transportation system were to be implemented within your organisation. The following questions would guide the SWOT analysis.

- How long can the service charge be kept free, or set at an attractive and affordable rate?
- What are the concerns and appropriate strategies to address the potential increase usage over time, particularly in augmenting the number of passengers, and in considering the inevitable growth of your organisation, over time?
- Given that EVs may operate at slower speeds than conventional vehicles (including acceleration after stops or on hillsides) what are the implication in terms of traffic flow and congestion, especially during the peak traffic hours during the mornings and afternoon periods? Would it be pragmatic to conduct a feasibility study?
- Should your organisation consider making a long-term infrastructure investment in a monorail system? What are the implications? Considering the associated cost of such a system, can a feasibility study be conducted?
- Is there potential to design a separate roadway or tract for EVs on campus? Does this concept warrant further research?
- As the batteries used in EVs pose environmental implications, including the use of rare earth minerals, what are the key concerns regarding hazardous waste management and the associated costs – particularly when taking into account the lifetime of these batteries?
- If EV passengers are actually cost-conscious stakeholders who do not own motorcycles or cars, will there be marked changes in their consuming behaviours?
- What are the implications of replicating the PSU on-campus model within the wider community of your organisation, particularly with respect to the aforementioned concerns?
- Should we judge that there are not definitive ‘right or wrong’ solutions as long as the decisions are implemented based on the collective and conscious minds of the stakeholders?

Worksheet 4: SWOT analysis

Strengths	Weaknesses
Opportunities	**Threats**

Working Session 5: Prioritising the stakeholders

Based on the SWOT analysis, and reflecting on Working sessions 1-4 above, list and rank the stakeholders whom your organisation should prioritise, in order to make the EV project successful.

Worksheet 5: Prioritising the stakeholders

Ranking the stakeholders	Justification for the prioritisation
1.	
2.	
3.	
4.	
5.	
6.	
7.	

Working session 6: Key Monitoring Actions

To implement the EV project, analyse the key monitoring actions for each of the following aspects and the associated persons in charge, within your organisation.

- Aspect 1: Green growth promotion activities should be well designed and take into account the organisation's policy, research strengths, and sufficient practical experience.
- Aspect 2: While compliance to national policies may permit a level of government funding, it may not be sufficient to sustain the programme's operation costs, and this may require support from local government, industry and the public.
- Aspect 3: An appropriate business plan and green business skills alongside a well organized operational procedure should be introduced to the personnel who will be required in and responsible for the sustainable operation of the system.
- Aspect 4: Communication and collaboration which are encouraged among nearby communities, industries and local governments, along with well and systematic documentation of events can serve to help sustain the overall operation process.

Aspect 5: Rigid definitions of terms and procedures could limit the learning and sharing among stakeholders and eventually decrease the level of support from the community.

Worksheet 6: Key monitoring actions

Key monitoring actions	**Key person(s) in charge**
Aspect 1	
Aspect 2	
Aspect 3	
Aspect 4	
Aspect 5	
Others	

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