

**UK PACT**



**Chula**  
Chulalongkorn University



# Achieving Low Carbon Growth in the City Through Electrified Urban Transport System in Thailand—E-transport in LCC





# Achieving Low Carbon Growth in the City Through Electrified Urban Transport System in Thailand—E-transport in LCC



United Nations Development Programme in Thailand  
12th Floor United Nations Building, Rajdamnern Nok Avenue Bangkok 10200,Thailand  
Email: [undp.thailand@undp.org](mailto:undp.thailand@undp.org) | Tel:+66 2 2883350

*UNDP is the leading United Nations organization fighting to end the injustice of poverty, inequality, and climate change. Working with our broad network of experts and partners in 170 countries, we help nations to build integrated, lasting solutions for people and planet. Learn more at [www.th.undp.org](http://www.th.undp.org) or follow at [@UNDP Thailand](https://twitter.com/UNDP_Thailand).*

## UK PACT

---

[www.ukpact.co.uk](http://www.ukpact.co.uk)

For any enquiries, please get in touch via email at [communications@ukpact.co.uk](mailto:communications@ukpact.co.uk)



# Preface

The Achieving Low Carbon Growth in the City Through Electrified Urban Transport System in Thailand project, or the E-Transport in LCC project, is a study conducted under collaboration among the United Nations Development Programme – Thailand, Chula Research of Chulalongkorn University, and Nakhon Ratchasima Municipality. Funded and overseen by the United Kingdom Partnering for Accelerated Climate Transition (UK PACT) – the Green Recovery Challenge Fund, the project is intended to be part of the collective effort to combat climate change.

To enable agencies concerned and interested parties to access complete information in a systematic manner about promotion of low-carbon city through electrified urban system, the study team has come up with the 'E-Transport in LCC Project Knowledge Management Package' as a source of pooled information obtained from the study. The package consists of a summary report of the Achieving Low Carbon Growth in the City Through Electrified Urban Transport System in Thailand project (this paper) and its highlights that can be applied to development of other mass transport systems, including:

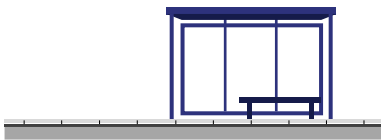
- Case studies of electrified mass transport system
- Gender equality and social inclusion in the E-Transport in LCC project
- Minimization of environmental and health impact caused by the E-Transport in LCC project
- Legal aspects concerning development of electrified mass transport system

The study team hopes that this package will be practically helpful for future development of electrified mass transport systems to drive low-carbon cities while tackling the climate change in an efficient and sustainable way.

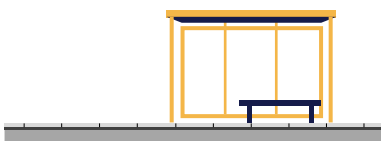
The study team  
October 2022



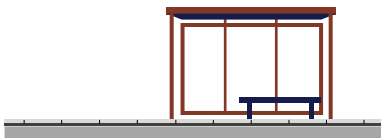
# Content



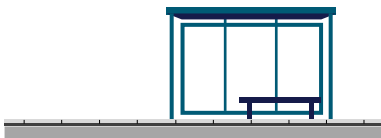
Introduction.....01



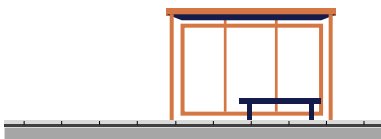
Electrified transport system design and project value analysis.....02



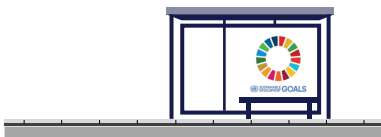
Analysis into greenhouse gas emissions and environmental impact.....05



Policy recommendations.....08



Gender equality and social inclusion (GESI) Issue.....10



Conformance to Sustainable Development Goals at the local level..12

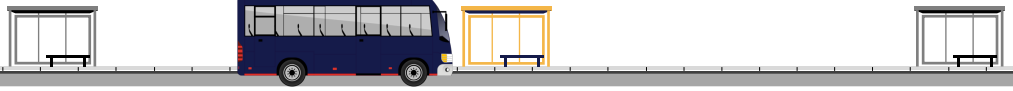






# Introduction

This policy study covers transport engineering dimension, environmental analysis, economic and legal analysis, as well as the gender equality and social inclusion (GESI) issue. Several tools that are relevant and internationally accepted were used in the study, including social demographic survey; construction of a transport engineering model, a greenhouse gas inventory model, and an air quality model; as well as financial and economic feasibility assessment. The study was carefully conducted step by step taking into consideration the benefit to traffic and transport planning at municipal and provincial levels. Importantly, the study must reflect local people's true travel demand and physical factors, with some other key assumptions like fares and estimated passenger volumes throughout the project readily included.



# Electrified transport system **design** and project **value analysis**

In the study, a survey was carried out to facilitate transport engineering design in terms of physical attributes of traffic infrastructure, such as road size and surface conditions, pavement size and surface conditions, and traffic island position and width, to assess practicality of these attributes. Data obtained from the survey was used for infrastructural design of the public transport system. Moreover, the household interview method was used together with a survey of traffic volumes and the Four-step Sequential Travel Demand Model, socio-economic survey, to assess travel demand, which provided facts and figures about current travel volumes and patterns that benefit the design of suitable transport routes.

To address people's travel patterns and needs in Nakhon Ratchasima Municipality, the study suggests the use of electrified transport system with stations located at suitable points. Five transport routes with 33 stations were recommended. One of these stations – Jor Hor Station – is designed to be an interchange station between purple and orange lines. To minimize any possible impact on the city traffic, some sections of the proposed routes are to be elevated, as detailed in Figure 1 which portrays 18 elevated stations and 15 overground stations.

## **Purple line**

designed with 17 stations spanning from Ubonrat School to Jor Hor Intersection, comprising 9.9 kilometres of overground section with 9 stations and 7.5 kilometres of elevated section with 8 stations

## **Orange line**

designed with 5 stations spanning from Terminal 21 Korat to Jor Hor Intersection, comprising 5.3 kilometres of overground section with 2 stations and 2.6 kilometres of elevated section with 3 stations

## **Red line**

designed with 8 stations, spanning from Pratu Nam Intersection to Industrial Estate, comprising 4.2 kilometres of overground section with 4 stations and 2.3 kilometres of elevated section with 4 stations

## **Yellow line**

designed with 4 stations spanning from Bypass Intersection to Pradoak Intersection, totally built overground stretching 5.3 kilometres

## **Green line**

serving as a feeder line with 4 stations to alleviate traffic congestion around the area starting from Mukka Montri Road through Nakhon Ratchasima Municipality to Thao Suranari Monument. The route will make use of the existing railway to transport commuters from the area around Sima Thani Hotel to Hua Talae Station.

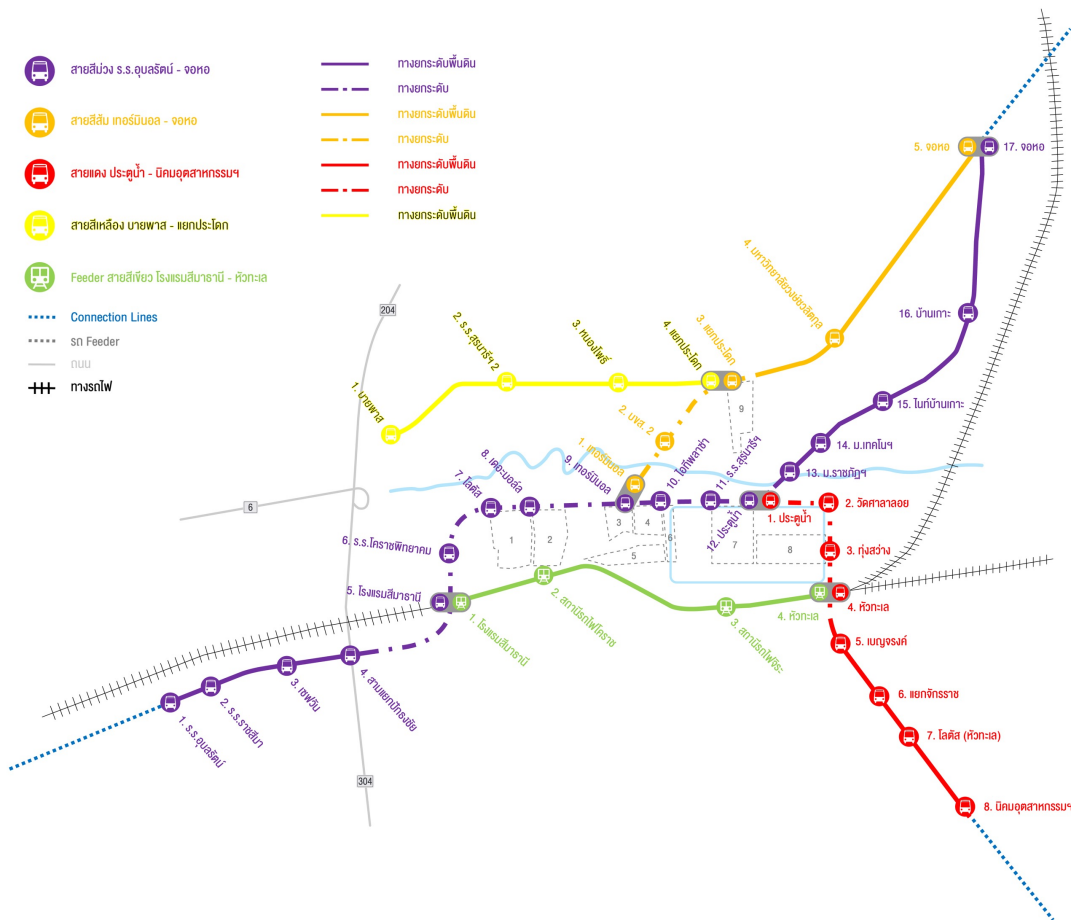


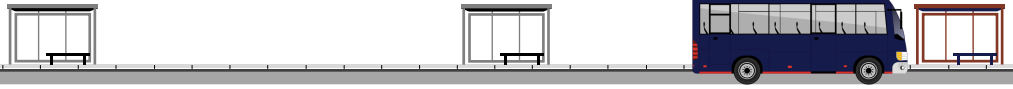
Figure 1 Proposed routes and stations

To promote daily commutes by electrified transport system on the five main routes, it is suggested that the two-row-seat minibuses are used as feeder vehicles to serve the needs of people living in Nakhon Ratchasima Municipality and surrounding areas. Remarkably, design of the mass transit system took into account the principle of ‘universal design’ to ably accommodate all groups of passengers, including women, children, the elderly, and those with disabilities.

The volume of passengers over the 20-year span of the project is estimated at 698 million passenger trips, or 95,590 passenger trips per day. This will create an expected total income of 7,967 million baht based on a fare rate of 15-25 baht. When revenues from advertising and rental of business space is incorporated, a total income of 9,479 million baht could be expected considering the current investment value of 3,732,100,000 baht. The investment covers station construction, e-bus procurement, charging stations, and other expenditures on personnel, maintenance and repair, as well as annual expenses (personnel operating cost, e-bus maintenance cost, fuel consumption cost, and charging

station operating cost), which will amount to 134,535,604 baht per year. Considering the net present value with a discount rate of 7.4%, the net return on the project investment will be 2,841 million baht.

The study provides the municipality with two investment options, i.e. making a sole investment in the project and making a 50% investment with the other 50% funded by loans from financial institutes. It was found that both options can provide a greater economic internal rate of return (EIRR) than the minimum acceptable rate of return (MARR) of 7.5% and a benefit-cost ratio (B/C ratio) of greater than 1. Even in the worst-case scenario when the operating cost shoots up by 20% while the number of passengers is lower than expectation by as much as 20%, or when the bus fare has to be reduced by 20%, the present value of the project still looks positive. In other words, the project can still generate profit from its operations. This could be concluded that the electrified public transport project in Nakhon Ratchasima is feasible and worth the investment.



# Analysis into **greenhouse gas emissions** and **environment impact**



Assessment of city carbon footprint (CCF) of Nakhon Ratchasima Municipality during 2018-2020 shows similar annual volumes, ranging between 428,097 and 442,370 tonnes carbon dioxide equivalent (tCO<sub>2</sub>e). In 2020, the size of carbon footprint was found a little bit smaller by 0.84%, as shown in Table 1 and Figure 2. Taking into consideration greenhouse gases emitted by each activity group, stationary fuel combustion was found to be the major contributor taking a share of 45.94% - 49.18% of total emissions, which are made up of electricity consumption (78.79% - 82.04%) and stationary fuel combustion (17.96% - 21.21%), followed by transport and waste management activities, which account for 29.13% - 35.86% and 17.15% - 24.08%, respectively. Volumes of greenhouse gas emissions caused by stationary fuel combustion in each year were found comparable. However, emissions caused by the transport sector show a sharp rise of 25.84% from 2019 to 2020 while emissions caused by waste management saw a decline by 31.07%.





Greenhouse gas emissions in Nakhon Ratchasima Municipality originated by the transport sector mostly come from road transport (81.00% - 86.63% of the total emissions), followed by emissions from the rail system (13.37% - 18.00%). The type of fuel in use and causes most of greenhouse gas emissions in the road transport sector is diesel (56.07% - 66.56%), followed by gasohol 91, 95 (E10) (12.89% - 16.22%). The figures point out to groups of users in industrial and commercial sectors as well as part of personal car users. Greenhouse gases emitted in the agriculture, forestry, and other land use (AFOLU) as well as industrial processes and product use (IPPU) were found very low, i.e. 0.91% - 1.11% and 0.14% - 0.15%, respectively. Greenhouse gas emissions in the AFOLU sector mainly come from land use and change of land use as well as the use of urea fertilizers while those in the IPPU sector came from two types of coolant, namely R-22 and R-32.

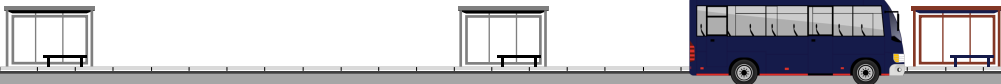


Table 1 Summary of greenhouse gas emissions during 2018-2020, categorized by activity groups

Activity groups	Volumes of greenhouse gas emissions (tCO <sub>2</sub> eq)		
	Year		
	2018	2019	2020
Stationary fuel combustion	212,308.13	208,903.99	196,663.43
%	(49.18%)	(47.22%)	(45.94%)
Transport	125,780.95	121,980.51	153,505.92
%	(29.13%)	(27.57%)	(35.86%)
Waste management	88,210.74	106,509.36	73,414.45
%	(20.43%)	(24.08%)	(17.15%)
IPPU	629.16	630.33	630.33
%	(0.15%)	(0.14%)	(0.15%)
AFOLU	4,803.85	4,346.78	3,883.01
%	(1.11%)	(0.98%)	(0.91%)
<b>Total emissions</b>	<b>341,732.83</b>	<b>442,370.98</b>	<b>428,097.14</b>

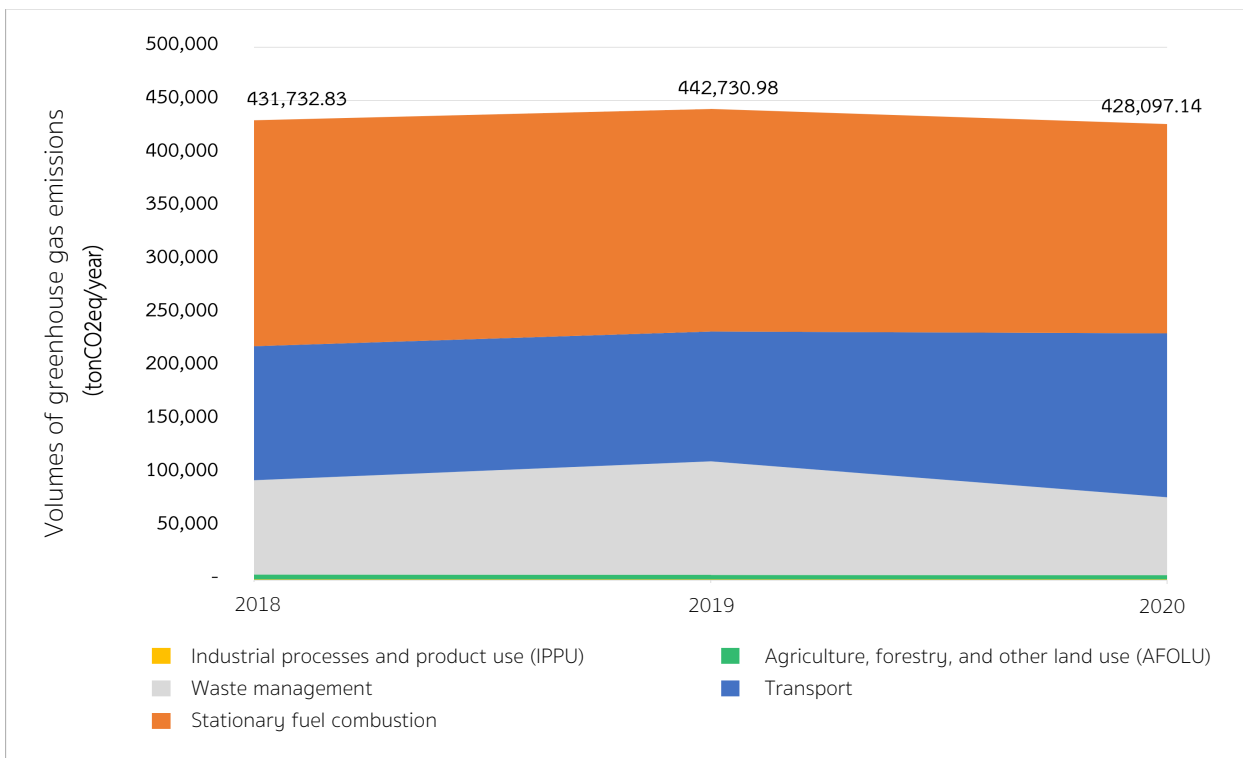


Figure 2 Carbon Footprint in Nakhon Ratchasima Municipality during 2018-2020



Forecast made into the change of greenhouse gas emissions (Figure 3) shows that emissions from the transport sector makes the sharpest rise, or 5.18% per year. Consumption of finished oil products in gasohol and diesel groups shows an increase of 7.19% and 2.54%, respectively. On the contrary, consumption of finished oil products in the forms of gasoline and LPG is moving on a downward trend. Emissions from the waste management sector rises by 3.02% per year while emissions from the stationary fuel combustion falls by 1.35%. The figures reflect the declining trend of stationary fuel consumption in the municipal area, both oil and electricity, thanks to the various measures intended for energy conservation coupled with technological advancement in the production of energy saving appliances.

The operations of electrified mass transit system will drive the municipality towards becoming a low-carbon city by reducing the size of carbon footprint through replacement of fossil fuel consumption with the electrified transport system. In 2027 and 2042, greenhouse gas emissions are expected to shrink by as much as 11,879 tCO<sub>2</sub>e and 43,539 tCO<sub>2</sub>e, respectively. The figures represent 7.05% and 13.21% of greenhouse gases to be reduced in the transport sector in the municipal area, accounting for 2.76% and 7.32% of the total emissions from all activities in the municipal area.

In addition to greenhouse gas reduction which is a main contributor to the attempt to become a low-carbon city, change of fuel types used in the transport sector to electricity will benefit air quality in the city. This means PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, and CO will be most reduced when compared with other pollutants. At the heart of Nakhon Ratchasima Municipality, around the Mitrapab Road (Highway no.2) and at the intersection connecting to Nakhon Ratchasima – Chokchai Road (Highway no 224), traffic volumes are expected to reduce most when the electrified mass transit system runs through the city. Considering the pollution reduction ratio and the base status, i.e. pollution caused by the current traffic, it was found that air pollution will be significantly reduced. A reduction of 13% - 17% will be achieved in 2027 and 31% - 41% in 2042. Therefore, the attempt to reduce emissions of PM<sub>2.5</sub> from road traffic in Nakhon Ratchasima Municipality by using the electrified mass transit system will consequently bring down the number of days when PM<sub>2.5</sub> levels exceed the criteria. However, PM<sub>2.5</sub> intensity in those days is only slightly above the criteria. The better air quality will, moreover, make the number of patients with respiratory diseases in the Nakhon Ratchasima municipal area reduce by 10% - 20%, which will consequently cut down related medical expenses by 21 million baht in 2027 and 41 million baht in 2042. The ease of PM<sub>2.5</sub> conditions will also depend on many other factors outside the Nakhon Ratchasima Municipality area, particularly the open-air burning of biomass which is a source of PM<sub>2.5</sub>.

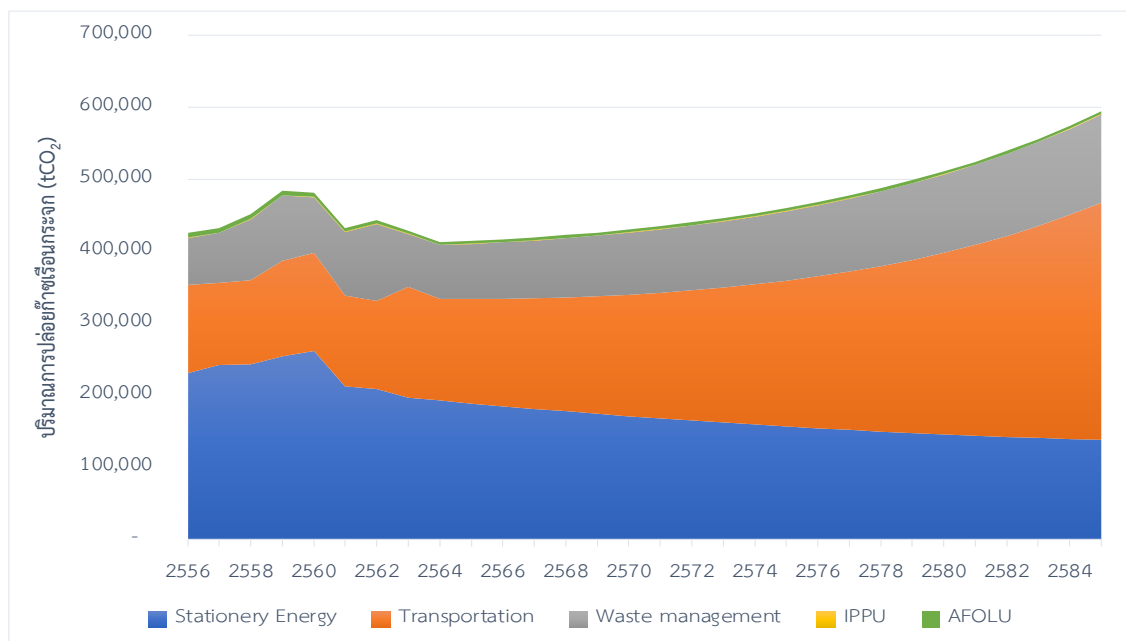


Figure 3 Carbon Footprint, categorized by activity group during 2020-2042

# Policy recommendations

Commuters using the conventional public transport (two-row-seat minibuses) and those using personal cars and motorcycles are the main groups targeted for behavioural change towards using the electrified mass transit system. The project set a strategic goal to achieve at least 100,000 passenger trips per day by the year 2042. The most critical factors determining development of the project are 'travel time and punctuality', followed by service quality, safety, and convenience. Bus fare is also considered a factor but not a major one to draw the target groups to mass transit system. To drive forward policy recommendations to achieve concrete results, proposals made by this study cover the following aspects:

## **Physical and infrastructural aspect:**

The design should ease people's physical limitations while providing convenience for women, children, the elderly, and the disabled. A project management plan should be drawn up to minimize pollution and impact on the traffic during the construction period. Bus routing and joint bus-service concessions are the topics to be discussed with overseeing authorities and two-row-seat minibus operators. Procurement of buses and energy supply should respond to passenger volumes.

## **Financial and investment aspect:**

Source of fund and form of investment are to be identified taking into consideration budget availability, private sector's interest, and public acceptance. The operator should be allowed to make some extra profit in addition to their revenues from bus fares, such as commercial space rental. Initial bus fares considered attractive to commuters are in the range of 15-25 baht per trip with special fares offered for students, the elderly, and the disabled.

## **Social aspect and public participation:**

Standards of service quality and safety for public buses are to be set, covering universal design and service operations. Measures for communicable disease control should also be introduced. Besides, a long-term urban and environmental development policy should be formulated, including city planning and land use, among other things.





## Development plan for E -bus system in Khorat Municipality

### Driving factors

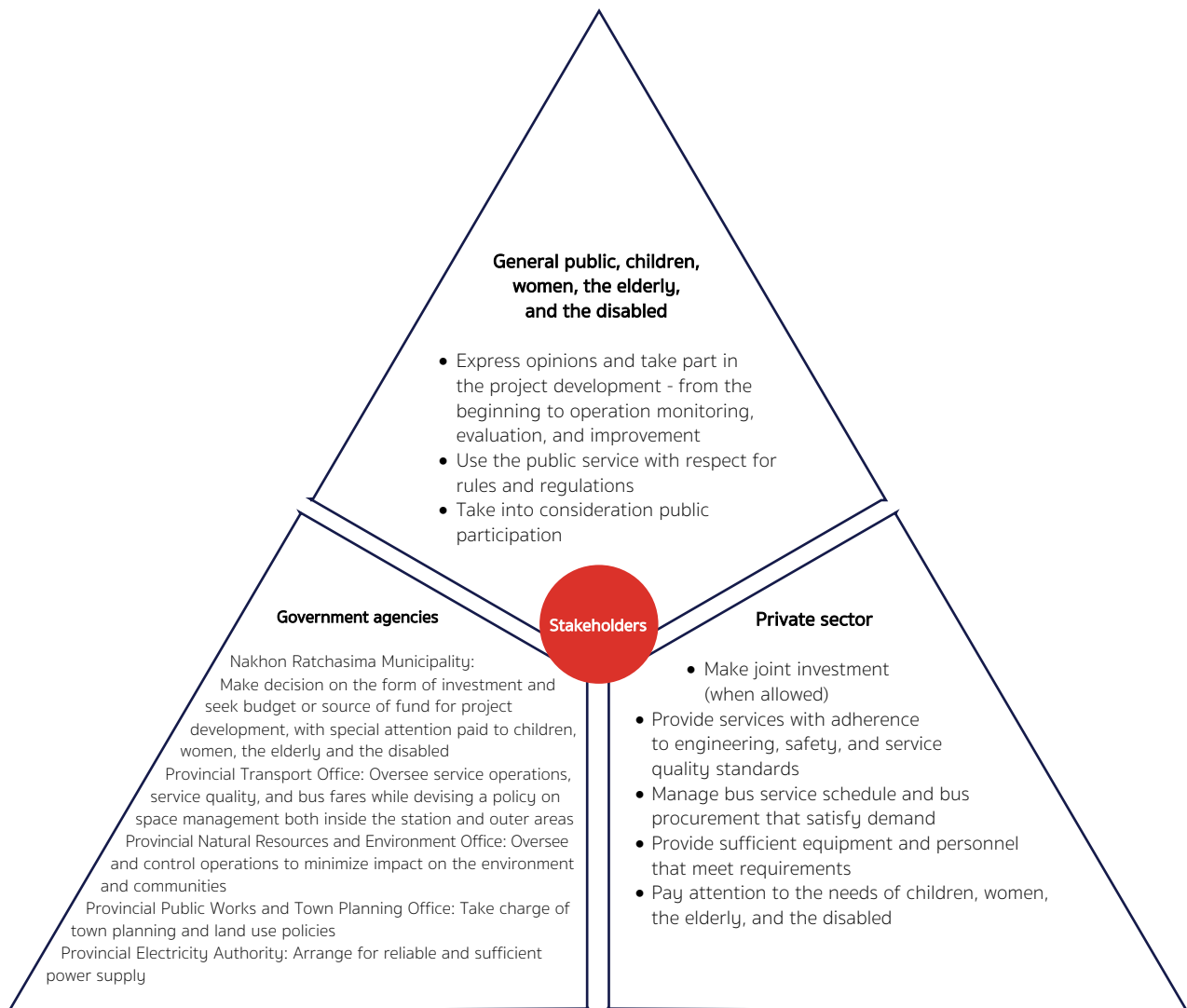


Traffic congestion problem    the need for travel convenience and safety    urban pollution (exceeding criteria)  
ambition to become a low-carbon city / smart city    high travel cost    the national goal of carbon neutrality

	Development phase (0-5 years) 2023-2027	Initial phase (6-15 years) 2028-2037	Fully deployment phase (16-25 years) 2038-2047
Strategic goals	E-bus system construction and readiness for use	A choice of travel mode for commuters  Target: 50,000 passenger trips/day	Fully fledged mass transit system with complete connections  Target: 100,000 passenger trips/day Economic profit = 2.72 billion baht GHG reduction = 295,696 tCO <sub>2</sub> e
Target groups	Nakhon Ratchasima Municipality	Passengers of two-row-seat minibuses, users of private cars and motorcycles	
Supporting policies	Physical and infrastructural aspect	Maintenance, infrastructural improvement, inspection, and evaluation	Infrastructure to facilitate connections
	Financial and investment aspect	Setting bus fares (10-25 baht per trip), extra income creation, and development of station's surrounding areas	
Public engagement and GESI	All groups of stakeholders' participation in project design and development	Safety measures, facilities for children, women, the elderly, and the disabled Continuous service improvement	
Impact mitigation	Collaboration with two-row-seat minibus operators on feeder routing	Integrated ticketing system to reduce passengers' financial burden, fair revenue sharing with two-row-seat minibus operators	

### Co-benefits and guidelines for mitigating impact on stakeholders

Co-benefits of the project should be publicized. For example, the electrified mass transit system will drive Nakhon Ratchasima Municipality towards becoming a smart city, traffic congestion will be eased, air pollution and health impact will be reduced, and greenhouse gas emissions will be lowered. Meanwhile, guidelines for mitigating impacts on stakeholders should be introduced, including cooperation with two-row-seat minibus operators in public transport network planning, profit sharing from the project with the existing operators and affected communities, among other things.





There are three legal dimensions to pay attention to in the development of electrified mass transit system in areas under the responsibility of Nakhon Ratchasima Municipality. They are 1] legal framework for regulating the establishment and operations of bus terminals and bus service; 2] finance and investment; and 3] public participation.

Nakhon Ratchasima Municipality has legal authority to provide public service in the form of electrified mass transit system and related operations under the Municipality Act, B.E. 2496 (1953). It may opt for keeping the operations under its own management as the project can be considered a commercial venture under Section 54 (12) and Section 57 of the Municipality Act, B.E. 2496 (1953). Also, it may opt for entering into a partnership with the private sector to seek support for project operations, which entails another two options. One involves procurement of government supplies and the other is establishment of a company or taking shares in a company limited who will take charge of the construction of bus stations or property development according to the design and details approved or agreed by the Land Transport Department together with equipment procurement.

In addition to design and details of bus stations, Nakhon Ratchasima Municipality (or the company established for project operations) will have to take into consideration the universal design to ensure users' convenience and safety under the relevant laws.

Nakhon Ratchasima Municipality is authorized for expropriation or purchase of land under private ownership as stipulated in Expropriation and Acquisition of Land and Immovable Properties, B.E. 2562 (2019), or lease of private properties under Public Procurement and Supplies Administration Act, B.E. 2560 (2017).

The municipality is, furthermore, authorized to use public domain under the Ministry of Interior regulation on Preservation and Protection of Public Domain Land for Common Use, B.E. 2553 (2010) and the Land Code. It is allowed to request for use of public domain which no person has the right to possess and is not the land for common use under the Land Code. The municipality has authority to the

use of land and railway belonging to the State Railway of Thailand under the State Railway of Thailand Act, B.E.2494 (1951).

To render public bus service, Nakhon Ratchasima Municipality will have to set bus station service fees according to the announcement of the Central Land Transport Regulatory Committee, which is the role of bus operators under the Land Transport Act, B.E. 2522 (1979). The operator who wishes to operate public bus service, be it a company limited or a government agency, must act in accordance with the Land Transport Act, B.E. 2522 (1979). Meanwhile, buses used for providing the service must conform to requirements stated in the Land Transport Act, B.E. 2522 (1979).

Nakhon Ratchasima Municipality should bear in mind that areas for rendering e-bus service must not cause troubles to people living in the vicinity. Such troubles may involve water sources, drainage channels, toilet, and waste that may cause smell or may become a source of disease carriers or may be harmful to health, with adherence to laws and regulations concerning communicable disease control.

To secure power supply for e-bus service, Nakhon Ratchasima Municipality may set up its own charging station for its own buses, which may be regarded as installation of a private charging station that receives power supply from the Provincial Electricity Authority (PEA). It may obtain a permit for doing a power sale business from the Energy Regulatory Commission (ERC) if it wishes to sell electricity from chargers to e-buses in the project and to private electric vehicles.

Nakhon Ratchasima Municipality may retain 75% of the bus fares collected for its own use while the remainder is to be remitted to the Treasury as state income as stipulated in the Land Transport Department's regulation on Revenues from Service Fees Collected at Passenger Terminals, B.E. 2564 (2021). There may be other sources of income from business space management both in and outside the station in the form of advertising fee and space rental.

# Gender equality and social inclusion (GESI) issue

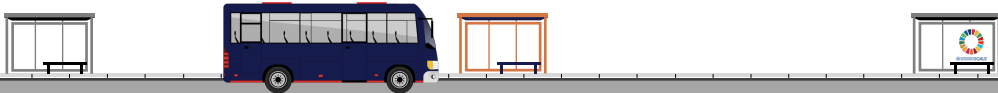
This project recognizes the issue of GESI and allows GESI participation in all stages of the project, starting from developing a GESI management plan in the mass transit policy. In this regard, the project sought consultation from GESI experts to ensure that the GESI issue is incorporated into all of project activities. The working team made a stakeholder analysis to identify key GESI groups, some of them are the Disabled People's Association, Office of Social Development and Human Security, Business and Professional Women's Association of Thailand, the Transportation for All Group, Lions Clubs in Thailand, the Land Transport Department, municipalities, and the province, etc.

The project already worked on phase 1 of the GESI issue, known as 'voice', by promoting participation in the project. Opinions from GESI groups, such as the disabled, women, and the elderly, are welcome at all stages of the project, from data survey and design to policy formulation in support of mass transit system development. The GESI issue has now proceeded into its phase 2, known as 'choice'. The workshop held to make decision on bus routing and infrastructural design of the mass transit system led to adoption of the 'universal design' concept and formulation of policies on long-term project development.

## Universal Design

- Universal Design (UD) is a concept of creative design for an environment accessible to all groups of people, be they the elderly, normal people, or those with disabilities. Universal design addresses barrier-free equipment and equal access to service areas, recognized as a concept for developing a better-quality social area without leaving anyone behind.
- The heart of universal design is public participation in the design, taking the various limitations in daily life into consideration in order to foster understanding of such limitations. The design process must satisfy the diverse lifestyles of people, the disabled and the elderly included, so that everybody will have an equal access to the service area. Universal design is based on seven principles:
  - 1) Equitable use: The design is applicable to everybody without the need to make any specific adjustment for any particular group of people.
  - 2) Flexibility in use: The design can accommodate diverse demands and abilities.
  - 3) Simple and intuitive use: The design is simple, easy to understand without the need to have experience, knowledge, or language skills.
  - 4) Perceptible information: The design can convey necessary information effectively using signs or images.
  - 5) Tolerance for error: The design allows for unintentional errors in use.
  - 6) Low physical effort: The design can be used easily, comfortably, and without effort.
  - 7) Size and space for approach and use: The design makes size and space easily reachable and truly practical.

<sup>2</sup> <https://f.hubspotusercontent10.net/hubfs/7376512/cp/general/UK%20PACT%20GESI%20Guidance.pdf>



Universal design in the mass transit systems may be witnessed in, for example, passenger lifts, use of ramps instead of stairs, signs or images that provide necessary information, wider access for wheelchair users or those with large piece of baggage, and seamless bridging between the station platform and vehicle body.



Photo credit: Centre for Excellence in Universal Design, Ireland



Photo credit: Centre for Excellence in Universal Design, Ireland



Photo credit: Australian Government



Photo credit: Pawat Laopaisartaksin

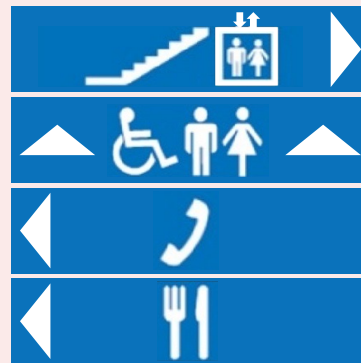


Photo credit: Centre for Excellence in Universal Design, Ireland



Photo credit: Pawat Laopaisartaksin

# Conformance to Sustainable Development Goals at the local level

The e-bus development project has a main objective to promote Nakhon Ratchasima Municipality as a low-carbon city. In conformance to Sustainable Development Goals, the project encourages SDG actions at the local level, including reduction in greenhouse gas emissions and air pollution caused by the transport sector (Goal 3 and Goal 13); improvement of infrastructure, quality of life, and access to basic mobility service (Goal 1 and Goal 11). In project operations, a network of stakeholders has been established to take part in project development (Goal 17). Equal participation by women and vulnerable groups, such as the disabled and the elderly, was also focused upon (Goal 5 and Goal 10).



## GOAL 1: No Poverty

- 1.1 International poverty
- 1.2 National poverty
- 1.3 Social protection
- 1.4 Access to basic services
- 1.5 Resilience to disasters
- 1.a Resources for poverty program
- 1.b Poverty eradication policies



## GOAL 2: Zero Hunger

- 2.1 Undernourishment and food security
- 2.2 Malnutrition
- 2.3 Small-scale food producers
- 2.4 Sustainable agriculture
- 2.5 Genetic resources for agriculture
- 2.a Investment in agriculture
- 2.b Agricultural export subsidies
- 2.c Food price anomalies



## GOAL 3: Good Health and Wellbeing

- 3.1 Maternal mortality
- 3.2 Child mortality
- 3.3 Communicable diseases
- 3.4 NCD & mental health
- 3.5 Substance abuse
- 3.6 Road traffic accidents
- 3.7 Sexual & reproductive health
- 3.8 Universal health coverage
- 3.9 Health impact of pollution
- 3.a Tobacco control
- 3.b R&D for health
- 3.c Health financing & workforce
- 3.d Management of health risks



## GOAL 4: Quality Education

- 4.1 Effective learning Outcomes
- 4.2 Early childhood development
- 4.3 TVET & tertiary education
- 4.4 Skills for employment
- 4.5 Equal access to education
- 4.6 Adult literacy & numeracy
- 4.7 Sustainable development education
- 4.a Education facilities
- 4.b Scholarships
- 4.c Qualified teachers



## GOAL 5: Gender Equality

- 5.1 Discrimination against women & girls
- 5.2 Violence against women & girls
- 5.3 Early marriage
- 5.4 Unpaid care and domestic work
- 5.5 Women in leadership
- 5.6 Reproductive health access & rights
- 5.a Equal economic rights
- 5.b Technology for women empowerment
- 5.c Gender equality policies



## GOAL 6: Clean Water and Sanitation

- 6.1 Safe drinking water
- 6.2 Access to sanitation & hygiene
- 6.3 Water quality
- 6.4 Water-use efficiency
- 6.5 Transboundary water cooperation
- 6.6 Water-related ecosystems
- 6.a Int. cooperation on water & sanitation
- 6.b Participatory water & sanitation mgmt.



## GOAL 7: Affordable and Clean Energy

- 7.1 Access to energy services
- 7.2 Share of renewable energy
- 7.3 Energy efficiency
- 7.a Int.cooperation on energy
- 7.b Investing in energy infrastructure



## GOAL 8: Decent Work and Economic Growth

- 8.1 Per capita economic growth
- 8.2 Economic productivity & innovation
- 8.3 Formalization of SMEs
- 8.4 Material resource efficiency
- 8.5 Full employment & decent work
- 8.6 Youth NEET
- 8.7 Child & forced labour
- 8.8 Labour rights & safe working env.
- 8.9 Sustainable tourism
- 8.10 Access to financial services
- 8.a Aid for Trade
- 8.b Strategy for youth employment





### SDG 9 Industry, innovation and infrastructure

- 9.1 Develop quality, reliable, sustainable and resilient infrastructure
- 9.2 Promote inclusive and sustainable industrialization
- 9.3 Increase the access of small-scale industrial and other enterprises
- 9.4 Upgrade infrastructure and retrofit industries to make them sustainable
- 9.5 Enhance scientific research, upgrade the technological capabilities of industrial sectors
- 9.a Facilitate sustainable and resilient infrastructure development in developing countries
- 9.b Support domestic technology development
- 9.c Significantly increase access to information and communications technology



### GOAL 10: Reducing Inequality

- 10.1 income growth (bottom 40%)
- 10.2 Inclusion (social, economic & political)
- 10.3 Eliminate discrimination
- 10.4 Fiscal & social protection policies
- 10.5 Regulation of financial markets
- 10.6 Inclusive global governance
- 10.7 safe migration & mobility
- 10.a Special & differential treatment (WTO)
- 10.b Resource flows for development
- 10.c Remittance costs



### GOAL 11: Sustainable Cities and Communities

- 11.1 Housing & basic services
- 11.2 Public transport systems
- 11.3 Sustainable urbanization
- 11.4 Cultural & natural heritage
- 11.5 Resilience to disasters
- 11.6 Urban air quality & waste mgmt.
- 11.7 Urban green & public spaces
- 11.a Urban planning
- 11.b Disaster risk management policies
- 11.c Sustainable & resilient buildings



### GOAL 12: Responsible Consumption and Production

- 12.1 Programmes on SCP
- 12.2 Sustainable use of natural resources
- 12.3 Food waste & losses
- 12.4 Managing chemicals & Wastes
- 12.5 Reduction in waste generation
- 12.6 Corporate sustainable practices
- 12.7 Public procurement practices
- 12.8 Sustainable development awareness
- 12.a Support for R&D capacity for SD
- 12.b Sustainable tourism monitoring
- 12.c Fossil-fuel subsidies



### GOAL 13: Climate Action

- 13.1 Resilience & adaptive capacity
- 13.2 Climate change policies
- 13.3 Climate change awareness
- 13.a UNFCCC commitments
- 13.b climate change planning & mgmt.



### GOAL 14: Life Below Water

- 14.1 Marine pollution
- 14.2 Marine & coastal ecosystems
- 14.3 Ocean acidification
- 14.4 Sustainable fishing
- 14.5 Conservation of coastal areas
- 14.6 Fisheries subsidies
- 14.7 Marine resources for SIDs & LDCs
- 14.a Research capacity & marine technology
- 14.b small-scale artisanal fishing
- 14.c implementing UNCLOS



### GOAL 15: Life On Land

- 15.1 Terrestrial & freshwater ecosystems
- 15.2 Sustainable forests management
- 15.3 Desertification and land degradation
- 15.4 Conservation of mountain ecosystems
- 15.5 Loss of biodiversity
- 15.6 Utilization of genetic resource
- 15.7 Protected species trafficking
- 15.8 Invasive alien species
- 15.9 Biodiversity in national & local planning
- 15.a Resources for biodiversity & ecosystems
- 15.b Resources for forest management
- 15.c Protected species trafficking (global)



### GOAL 16: Peace, Justice, and Strong Institutions

- 16.1 Reduction of violence & related death
- 16.2 Human trafficking
- 16.3 Justice for all
- 16.4 illicit financial & arms flows
- 16.5 Corruption and bribery
- 16.6 Effective institutions
- 16.7 Inclusive decision-making
- 16.8 Inclusive global governance
- 16.9 Legal identity
- 16.10 Public access to information
- 16.a capacity to prevent violence
- 16.b Non-discriminatory laws



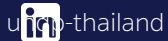
### GOAL 17: Partnerships for the Goals

- 17.1 Tax & other revenue collection
- 17.2 ODA commitment by dev. countries
- 17.3 Additional financial resources
- 17.4 Debt sustainability
- 17.5 Investment promotion for LDCs
- 17.6 Science and tech int. cooperation
- 17.7 Transfer of technologies
- 17.8 Capacity building for ICT
- 17.9 Capacity building for SDGs
- 17.10 Multilateral trading system (WTO)
- 17.11 Exports of developing countries
- 17.12 Duty-free market access for LDCs
- 17.13 Global macroeconomic stability
- 17.14 Policy coherence for SD
- 17.15 Respect country's policy space
- 17.16 Global partnership for SD
- 17.17 Partnerships (public, private, CSO)
- 17.18 National statistics availability
- 17.19 Statistical capacity



[www.th.undp.org](http://www.th.undp.org)

United Nations Development Programme in Thailand  
12th Floor United Nations Building, Rajdamnern Nok Avenue  
Bangkok 10200, Thailand  
Email: [undp.thailand@undp.org](mailto:undp.thailand@undp.org)  
Tel: +66 2 288 3350



# UK PACT

---

[www.ukpact.co.uk](http://www.ukpact.co.uk)

For any enquiries, please get in touch via email at [communications@ukpact.co.uk](mailto:communications@ukpact.co.uk)