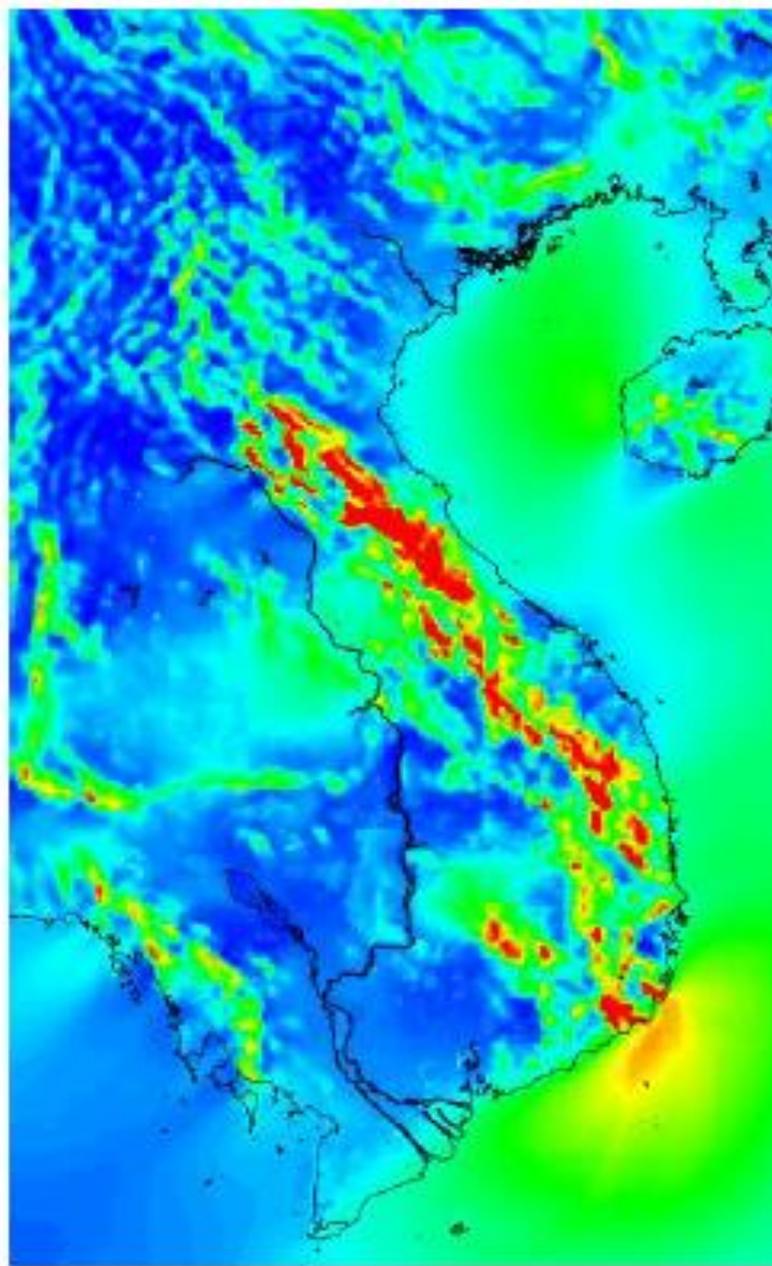
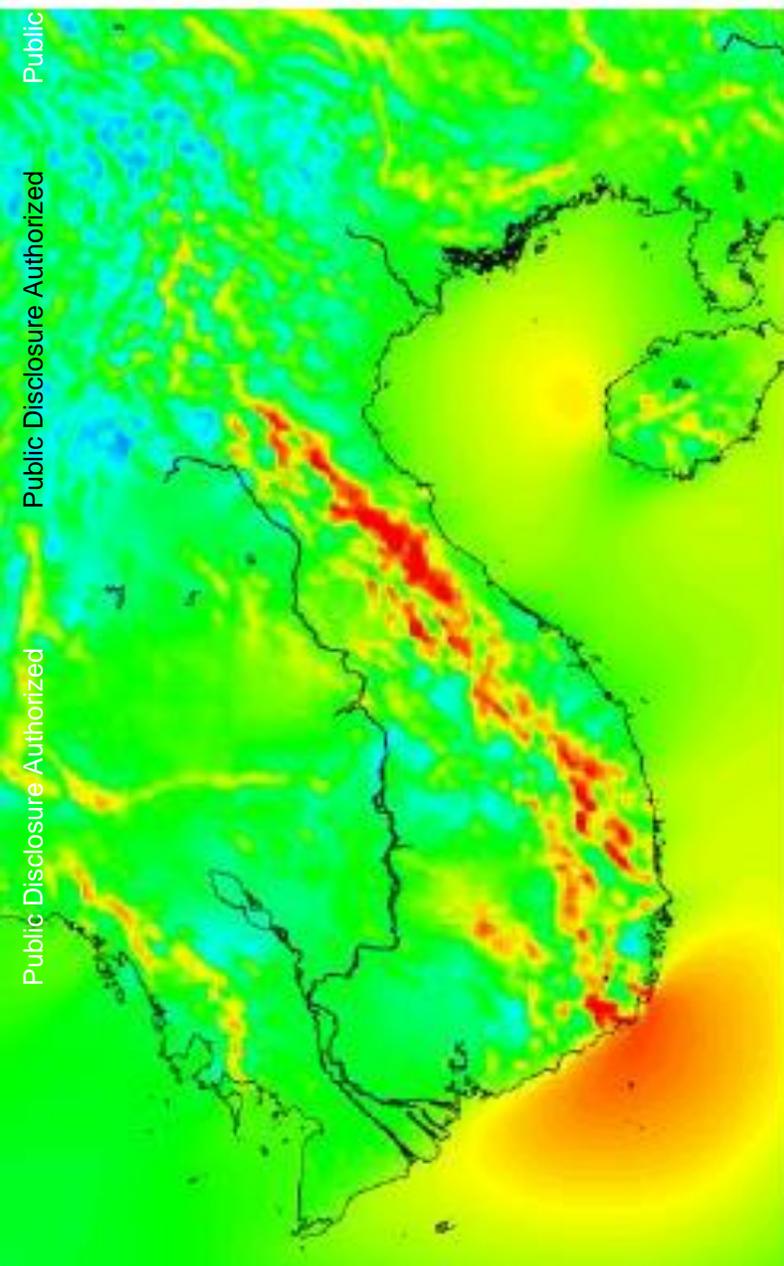


# Wind Resource Mapping in Vietnam

## PHASE 2 IMPLEMENTATION PLAN

SEPTEMBER 2015



This report was prepared by [DTU Vindenergi](#), under contract to [The World Bank](#).

It is one of several outputs from the wind **resource mapping component of the activity “Renewable Energy Resource Mapping and Geospatial Planning – Vietnam”** [Project ID: P145513]. This activity is funded and supported by the Energy Sector Management Assistance Program (ESMAP), a multi-donor trust fund administered by The World Bank, under a global initiative on Renewable Energy Resource Mapping. Further details on the initiative can be obtained from the [ESMAP website](#).

This document is an **interim output** from the above-mentioned project. Users are strongly advised to exercise caution when utilizing the information and data contained, as this has not been subject to full peer review. The final, validated, peer reviewed output from this project will be the Vietnam Wind Atlas, which will be published once the project is completed.

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## 1. INTRODUCTION

The World Bank (WB) in partnership with the General Department of energy (GDE) under the Ministry of Industry and Trade (MoIT) is implementing an activity titled “Renewable Energy Resource Mapping and Geospatial Analysis:Vietnam”, which includes assessment and mapping of wind resource. The objective of the activity, which is funded by the Energy Sector Management Assistance Program (ESMAP) under their global initiative on Renewable Energy Resource Mapping, is to improve the awareness of the government and the private sector of the resource potential of wind and provide the government with a geospatial planning framework to guide commercial investment in the sector. The initiative supports five phases of resource mapping and geospatial planning activities, as illustrated by Figure 1. This assignment relates to Phase 2 for wind mapping component, and involves the planning and delivery of a wind measurement campaign in Vietnam.

**Figure 1:** Five phases of RE resource mapping being supported under the ESMAP initiative



In Phase 1, the Denmark Technical University's Wind Energy Department (DTU Wind) delivered their interim outputs for the mesoscale wind modeling in June 2014. DTU Wind recommended installing six additional wind masts in various locations, and undertaking complementary LIDAR measurements to better understand the low-level jets that may exist in several locations.

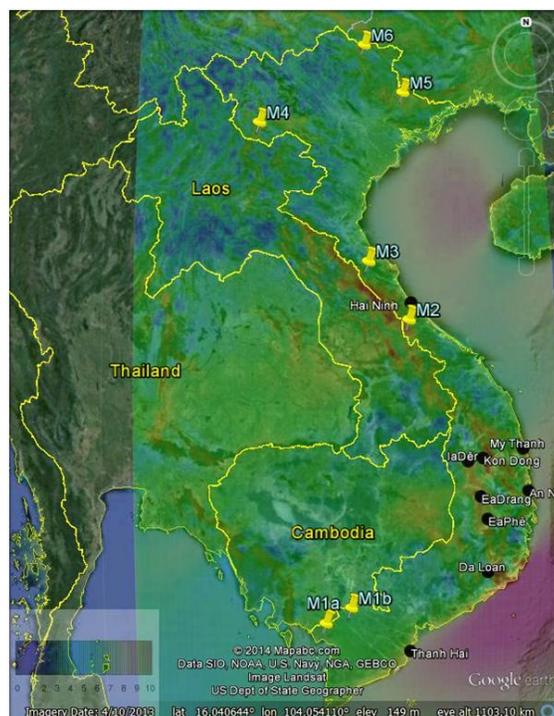
The objective of this project is to support the development of the Vietnam Wind Atlas by planning and delivering a wind measurement campaign in Vietnam consisting of six mast sites and one LIDAR unit over a period of 24 months at locations to be jointly agreed with the WB and DTU Wind.

## 2. SITE SELECTION

According to the recommendations from DTU Wind, the six sites for wind mast measurements shall be located in the following areas, as illustrated in Figure 2:

- + 1 site in the south-west of the country, near the border with Cambodia (M1a or b);
- + 2 sites in the middle of the country, near the border with Laos (M2 and M3);
- + 1 site in the north-west of the country, near the border with Laos (M4);
- + 2 sites in the north-east of the country, near the border with China (M5 and M6).

**Figure 2:** 06 sites for wind measurement masts recommended by DTU Wind



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PECC3 has conducted surveying 06 locations proposed to erect wind measurement mast. General comments, except to locations M1 in the Mekong Delta region with the terrain is relatively clear and simple, the remaining positions are located in hilly areas, remote location, difficult terrain, difficult to access, sparsely population, that difficult choice appropriate location.

## 2.1. Site selection criteria

The criteria used to select mast location as follows:

- + From 5 to 10 km distance to areas with complex terrain (ground slope greater than 30°);
- + Far 5-7km away from the coast;
- + Relatively homogeneous area of roughness;
- + Near residential areas to ensure security;
- + The area near roads to ensure the transportation of materials, construction equipment;
- + Contains phone signal is relatively good;
- + The land is relatively wide enough to lay mast foundation and the anchor foundations;
- + Agricultural land, private ownership to easily negotiate the lease with reasonable costs.

In addition, in case of M2 and M3 positions, we also have to select the location for LIDAR equipment installation with the following additional criteria:

- + Next to the houses, with people often present in the house and agreed to lease land and protection equipment;
- + Distance related to the wind measurement mast is not greater than 100m.

## 2.2. Site selection process

Given the above selection criteria, the site selection process has been designed as consisting of 3 sequential steps as follows:

*Step 1: Gather information* about current traffic conditions, access capability to the proposed location, planned some appropriate position with the selection criteria. This step is done in the office, using supported tools like Google Map, Google Earth;

*Step 2: Schedule field trip.* Based on information about weather forecasts, information on the types of vehicles available and their schedules, plan field trips suitable and

effective. The information is accessible from the internet and telephone exchange.

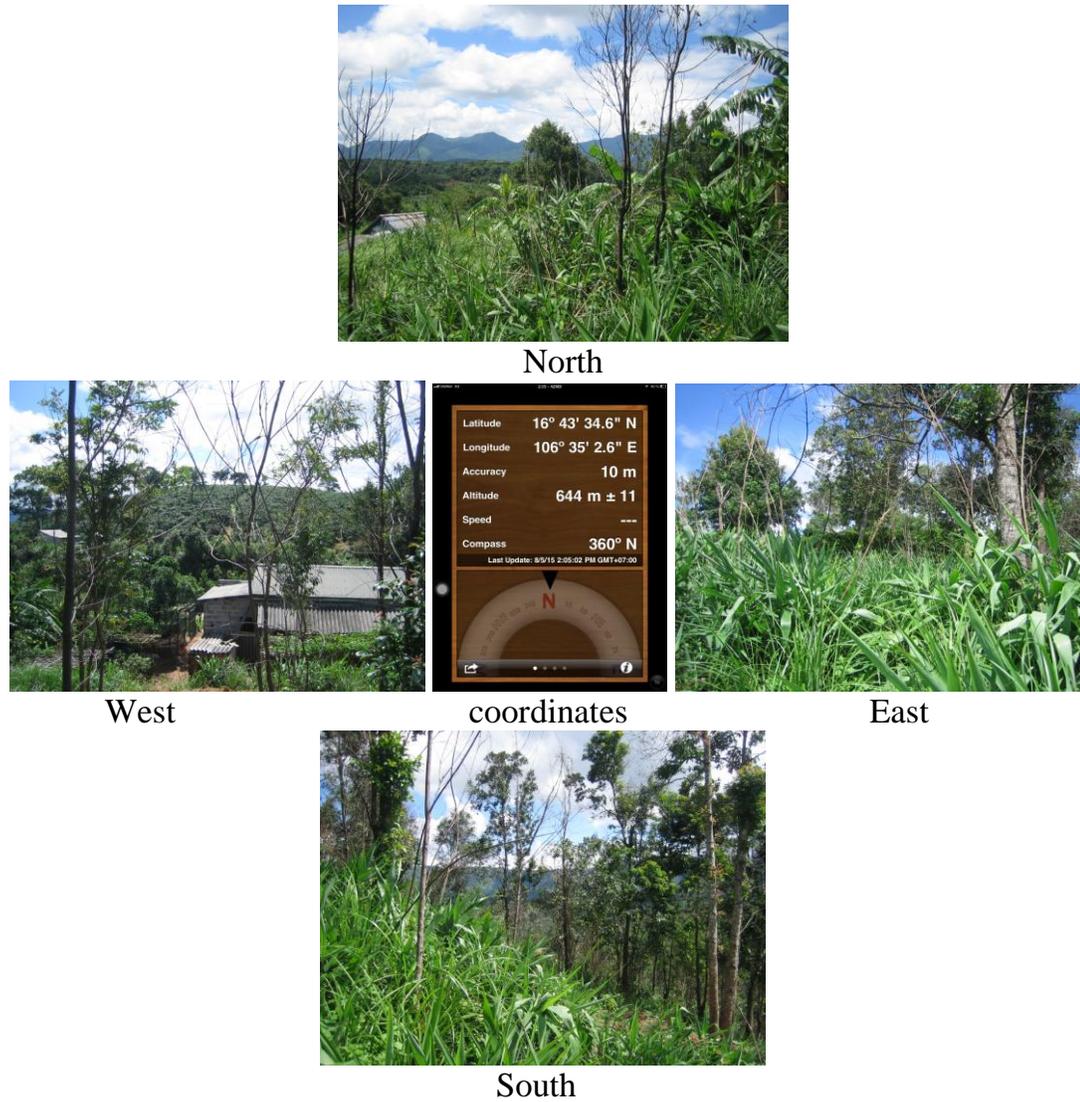
*Step 3: Carry out site visit to candidate sites, gather appropriate data. As the above steps are essentially desk study. An actual site visit would help gather actual and reliable data, which again could refine the evaluation.*



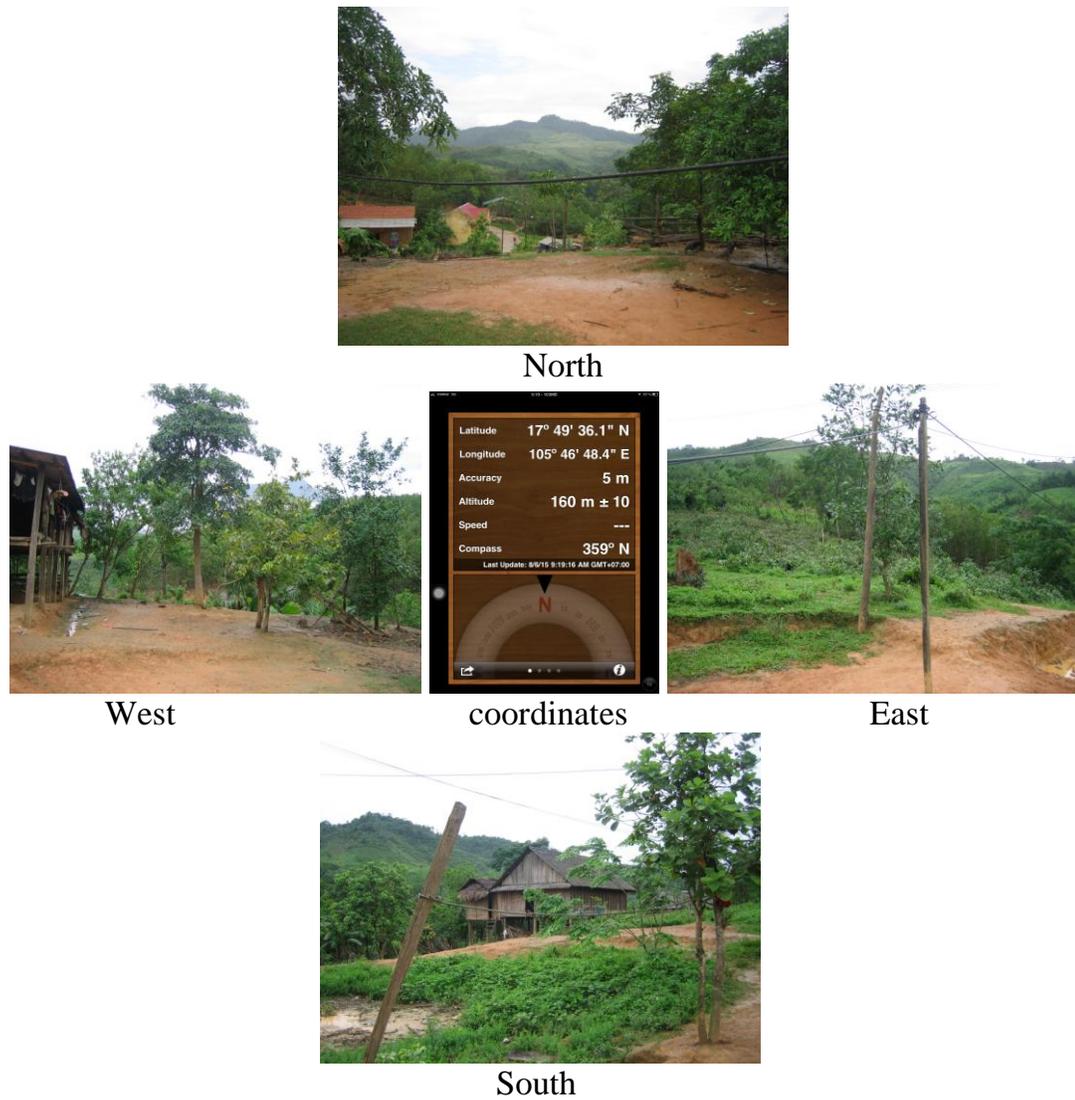
**Figure 3:** Panorama view of proposed location M1a



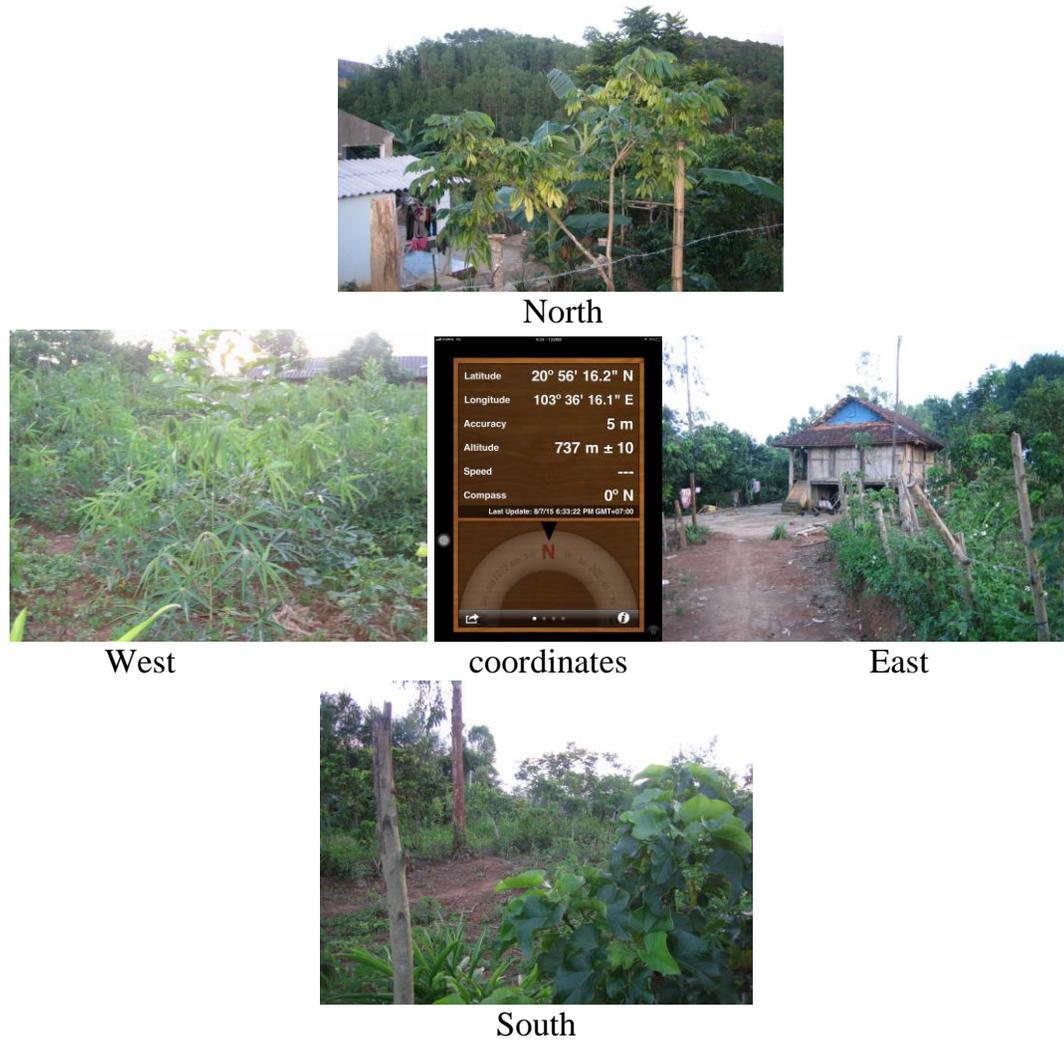
**Figure 4:** Panorama view of proposed location M1b



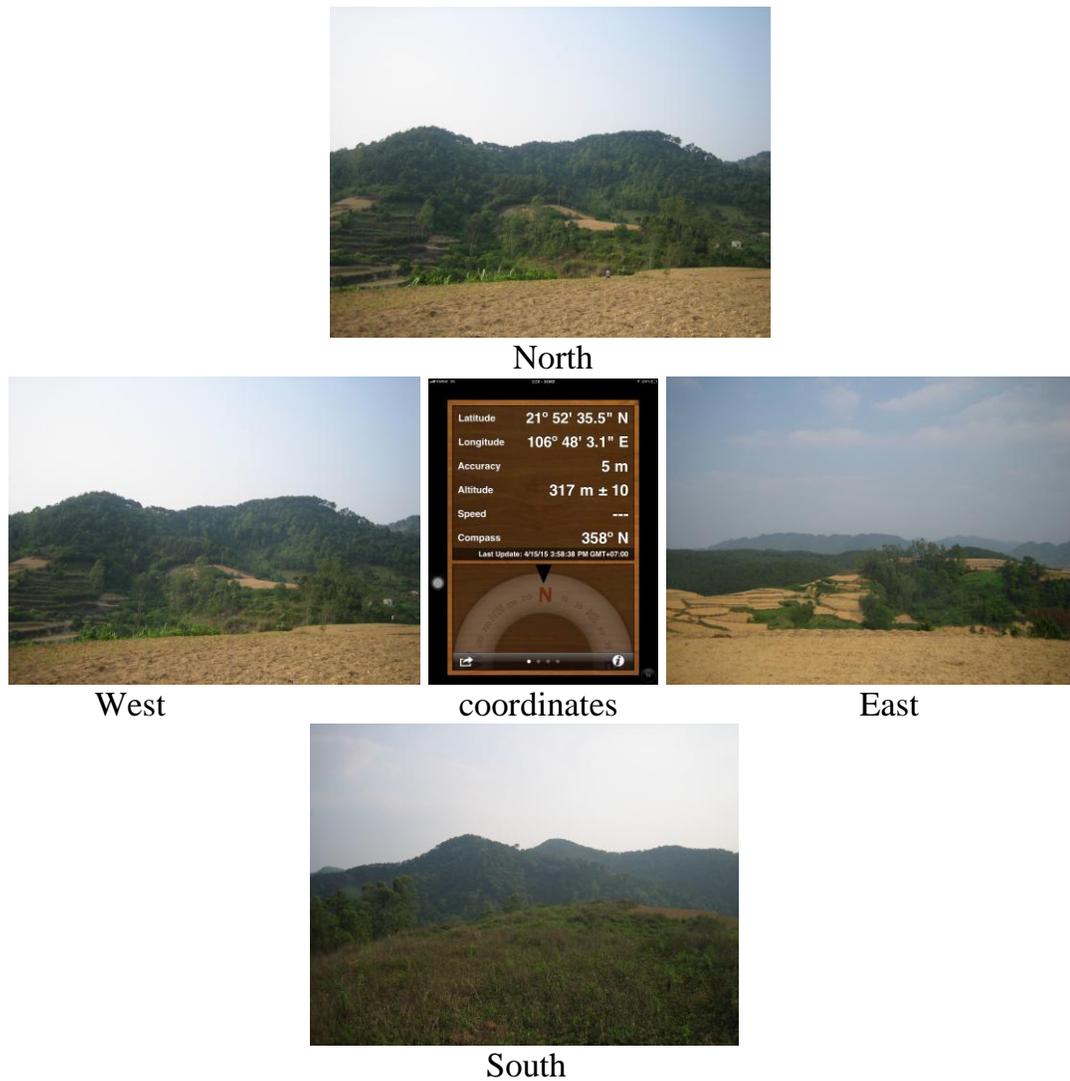
**Figure 5:** Panorama view of proposed location M2



**Figure 6:** Panorama view of proposed location M3



**Figure 7:** Panorama view of proposed location M4



**Figure 8:** Panorama view of proposed location M5



North



West



coordinates



East



South

**Figure 9:** Panorama view of proposed location M6

Selection results are summarized in the table below:

**Table 1:** Information of site selection

Location	M1a	M1b	M2	M3	M4	M5	M6
Commune	Kiên Bình	Lê Chánh	Hướng Phùng	Dân Hóa	Sốp Cộp	Cao Lộc	Lương Thông
District	Kiên Lương	Tân Châu	Hướng Hóa	Minh Hóa	Sốp Cộp	Cao Lộc	Thông Nông
Province	Kiên Giang	An Giang	Quảng Trị	Quảng Bình	Sơn La	Lạng Sơn	Cao Bằng
Co-ordinate							
Latitude	N10o16'23"	N10o44'44"	N16o43'35"	N17o49'36"	N20o56'16"	N21o52'36"	N22o47'46"
Longitude	E104o39'55"	E105o11'04"	E106o35'03"	E105o46'48"	E103o36'16"	E106o48'03"	E106o02'05"
Altitude	10m	2m	644m	160m	737m	317m	616m
Distance to city/ provincial town	60km	15km	90km	135km	125km	5km	40km
Time to survey location	24-Mar	24-Mar	5-Aug	6-Aug	7-Aug	15-Apr	16-Apr
Land owner	private	private	private	private	private	private	private
Existing land use	Paddy growing	Paddy growing	Uncultivate d land	Uncultivated land	Manioc growing	Corn growing	Uncultivated land
Terrain	Plat terrain	Plat terrain	hills	Steep hills	hills	Steep hills	Steep hills
Access capability	Easy	Easy	Difficult, has to use FWD vehicles	Difficult, has to walk 50m	difficult	Difficult, has to walk 50m	Difficult, has to walk 100m
Security	good	good	good	good	good	good	good
Telephone signal	strong	strong	medium	medium	medium	strong	medium

At the expected location for LIDAR equipment installation, we also have a preliminary agreement position with the land owners:

+ Location M2: Owner's name: Tran Huu Ky, address: Huong Hai village, Huong Phung commune, cell phone number: 01.697.045.919.

+ Location M3: Owner's name: Tran Thi Mai, address: Ta Leng village, Dan Hoa commune, Minh Hoa district, cell phone number: 0964.654.041.

### 3. DESIGN OF WIND MASTS AND CIVIL WORKS

The measurement mast was designed based on the input requirements and the design was done previously for similar projects of PECC3 (see drawing file *Ban ve cot do gio-WB.pdf* attached).

Due to road access to locations from M2 to M6 are complex, wind measurement mast

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will use the sections 3m to erect, for M1 position, may use 6m-sections to save time and cost.

#### **4. PROPOSALS FOR SELECTION AND PROCUREMENT OF THE WIND MEASUREMENT EQUIPMENT AND SUB-CONTRACTORS**

+ Choosing construction contractor(s):

Due to work requires experienced contractors, done in a short time, we propose to select contractors according *Sample\_RFQ\_for\_national\_shopping* similar the procedure was done for Wind Resource Assessment Project (performing 2008, also financed by the WB). Bidding documents include:

- Request for quotation;
- Technical requirement;
- Technical drawings of wind mast.

(See draft attachments).

A list of the construction contractors will be selected to send invitations by PECC3 (at least 03 contractors).

+ Procurement of equipment:

In recent years, over 50 wind measurement masts were erected in Vietnam, most of the sensors are from 02 suppliers/ producers is: NRG (USA) and Ammonit (Germany). Wind Resource Assessment Project Project has also used the sensors of NRG. The project's 10 wind measurement mast of GIZ (Germany) chose Ammonit sensors. Expert of PECC3 also has extensive experience in the installation, operation and troubleshooting of the measuring equipment of 2 this suppliers. Recently, PECC3 sent a letter proposed a full set of equipment bids for wind measurement campaign this time. The companies also sent quotation feedback (see the attached file *equipment\_offer* ...). Preliminary quotation results for the 06 sets of measuring equipment, do not take into account the backup, as follows:

- The NRG: 1,818,432,000 VND, which is the cost delivery to the headquarter of PECC3 because the company has the exclusive agent in Vietnam;
- The Ammonit: having to 02 options: (1) Good offer: 78,485.59 Euro; (2)

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Luxury offer: 86.730 Euro. This offer quotation includes shipping costs to Vietnam. However, to ship to the headquarter of PECC3, have incurred expenses include: (1) import duty of 5% of shipments; (2) 10% VAT; customs fees, service and transportation from the airport to about 2%.

Thus, if we compare the cost of procurement to headquarter of the clients, applicable exchange rates 24,000 VND/Euro, the more expensive price Ammonit equipment from 22% (in case of selecting Good offer) to 35% (in case of selecting the Luxury offer). Recommend to select the NRG's equipment for this campaign because of lower costs. Procurement contracts may be signed directly between PECC3 and NRG or between construction contractor and NRG (i.e. construction contractor is a general contractor for construction and procurement, the Request for Quotation was drafted according to this plan).

## **5. PROCEDURE FOR OBTAINING PERMITS AND LOCAL PERMISSION**

Following to the Construction Law, the wind measurement mast works exempt from construction permits (works under construction investment projects are decided investment by Ministers, heads of ministerial-level agencies, the presidents of the people at all levels; temporary works; technical infrastructure works in the rural areas, ..).

In preparation for the construction, the GDE will notify the relevant local authorities (commune, district and province) of wind measurement program and offered assistance when needed. PECC3 will draft the written form and sent to the WB to request the GDE for issuing.

During the construction phase, the construction contractor will liaise with local authorities to introduce and recommend support, help complete the work if necessary.

In addition, PECC3 and construction contractor coordinated choose exactly location to place wind measurement mast, negotiating land lease and security contract with the land owners or local authorities.

## **6. PROPOSED CAPACITY BUILDING AND TRAINING MEASURES FOR LOCAL PARTNER(S) AND SUB-CONTRACTORS(S)**

+ Improve capacity for local consultants:

During this time of the wind measurement campaign, have used a new device to the Vietnam market, LIDAR equipment. The instructions for proper installation, operation

and maintenance is essential. The guide is definitely foreign experts (possibly an expert from the DTU Wind), and to work effectively guide and replication capabilities in the future, should hold a minimum participants enrollment (about 06 people).

The venue may be at PECC3's headquarter or in the field (location M2) if possible. Time organization: even after the device is transferred to Vietnam and assembly locations in M2 was ready.

+ Training installing equipment to subcontractors:

In the case of the construction contractor is unfamiliar with measurement equipment, PECC3 will organize to guide on site for employees of contractors. The installation of equipment on each mast will be monitored continuously by specialists of PECC3.

When completed the installation, specialist of PECC3 will complete the installation reports with the assistance of installation personnel.