EMBASSY OF DENMARK
Hanoi

DEVELOPMENT OF TECHNICAL STANDARDS FOR WIND SITE INVESTIGATION IN VIETNAM

PETROVIETNAM VPI

CONSULTATION MEETING

Geophysical & Geotechnical Surveys: Insights from The Draft Report of Technical Standard for Site Investigation in Support of Bidding for Offshore Wind Power Projects in Vietnam

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Vietnam's Offshore Wind Ambition

Strategic Goals

- Energy Security
- Carbon Neutrality by 2050
- Economic Development

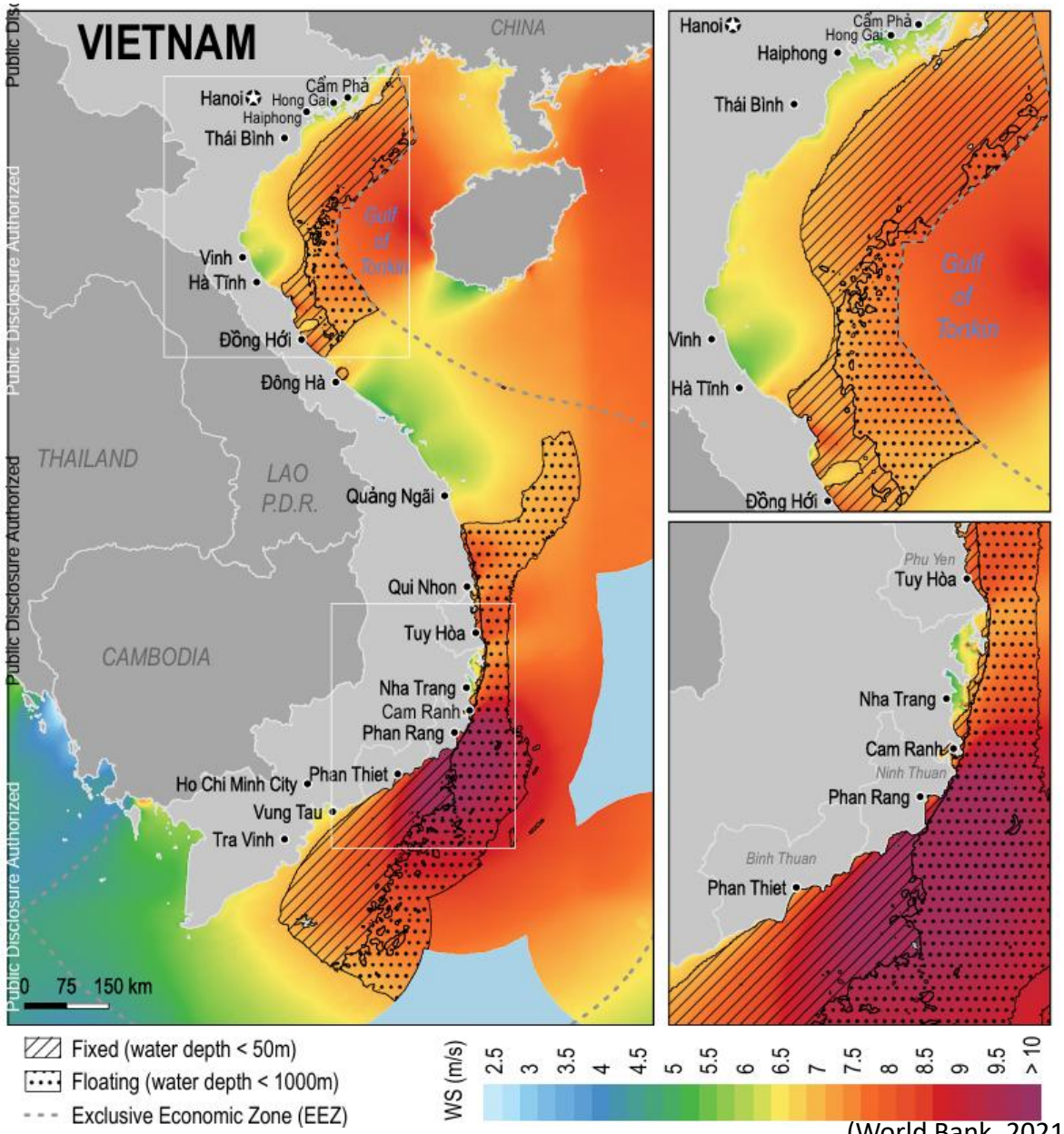
3,200 km Coastal line

Exceptional wind resources

PDP8 Revised Target

6-17 GW

In the period of 2030-2035



(World Bank, 2021)

The 3-Phase Investigation Framework

Phase 1
Desktop Study
Fatal flaw analysis using existing data

Cost: $80K-$100K

Timeline: 2-4 months

Phase 2
Reconnaissance
Broad-area geophysical & initial geotechnical surveys

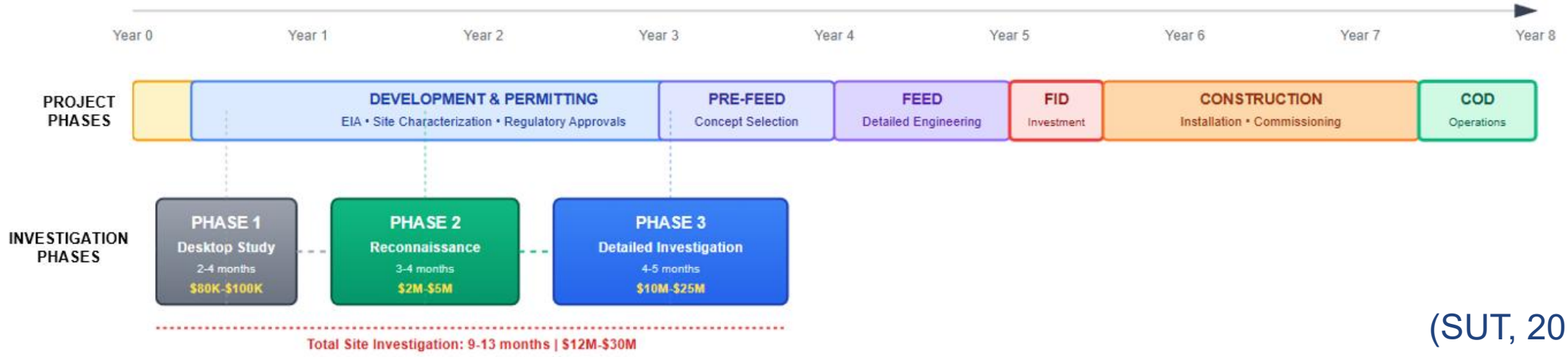
Cost: $2M-$5M

Timeline: 3-4 months

Phase 3
Detailed Investigation
High-resolution targeted surveys for bankable data

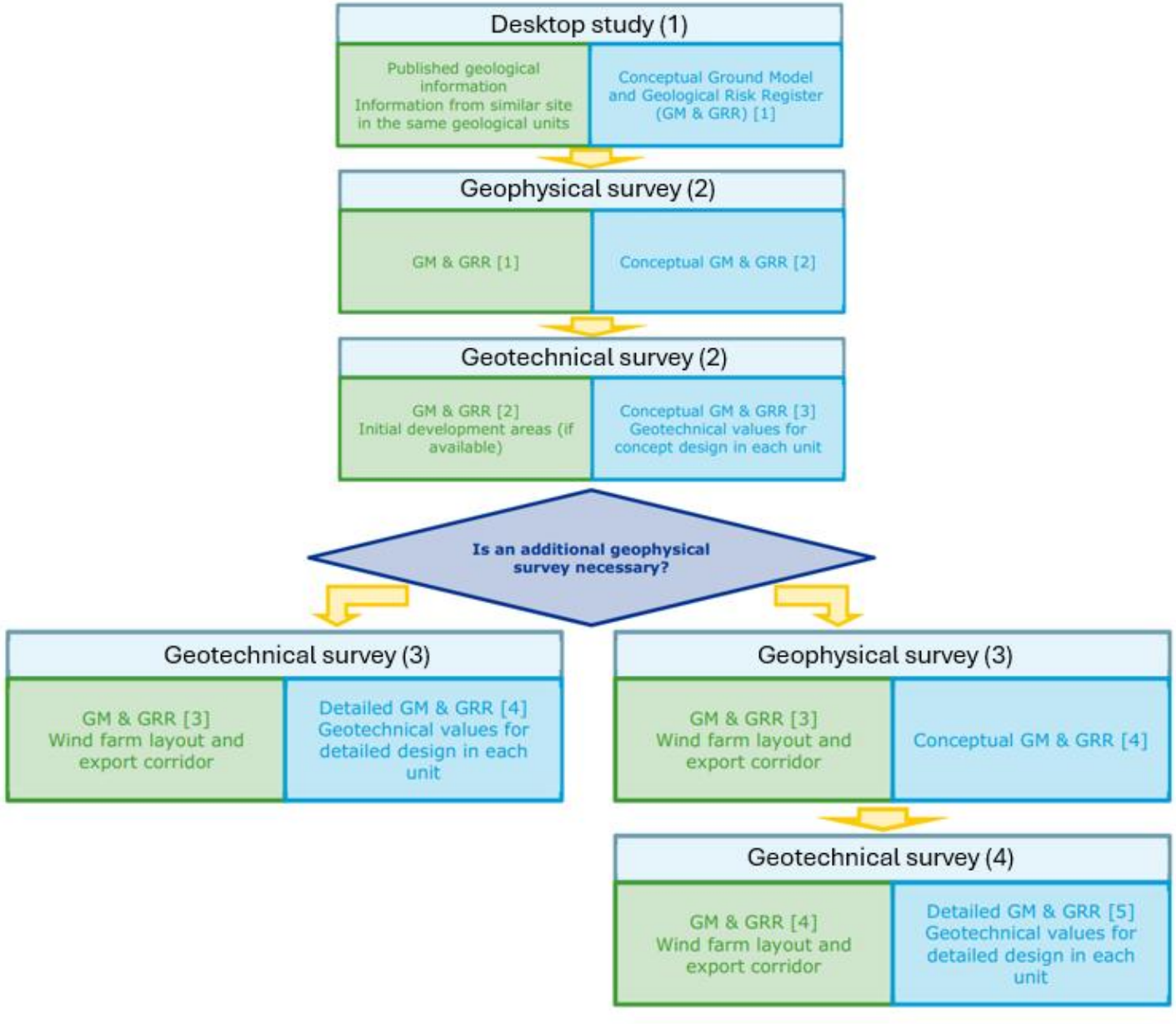
Cost: $10M-$25M

Timeline: 4-5 months



(SUT, 2019)

The 3-Phase Investigation Framework



(SUT, 2019)

Phase 2: Geophysical Reconnaissance Survey

Survey Equipment & Methods

Multibeam Echosounder (MBES)

High-resolution bathymetry (1-2m grid)

Side-Scan Sonar (SSS)

Seabed features, boulders, debris

Sub-Bottom Profiler (SBP)

Shallow geology (<50m depth)

Magnetometer

UXO detection, ferrous objects

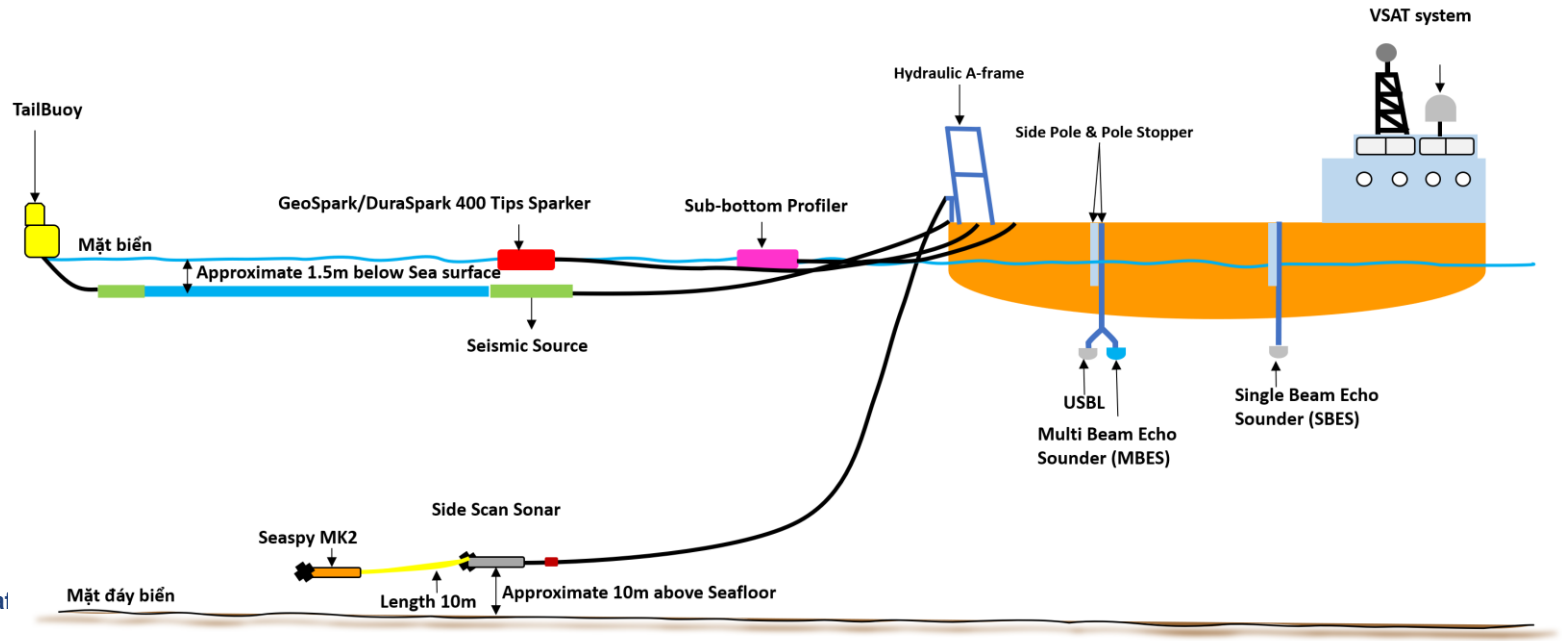
Key Parameters

Line Spacing: 250-500m

Timeline: 4-8 weeks

Cost: $2-5M





Multibeam Echosounder (MBES)

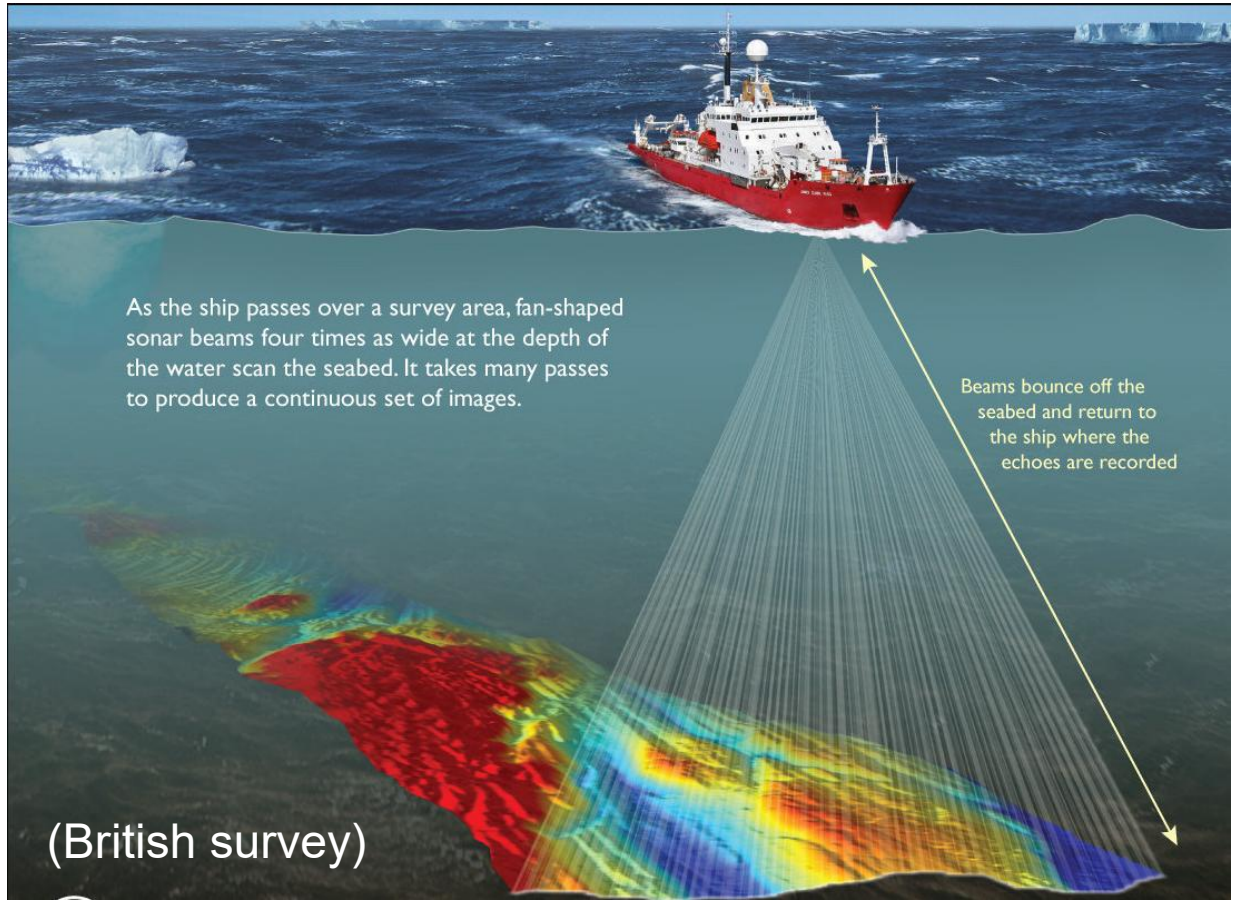
High-Resolution Seabed Mapping

Applications

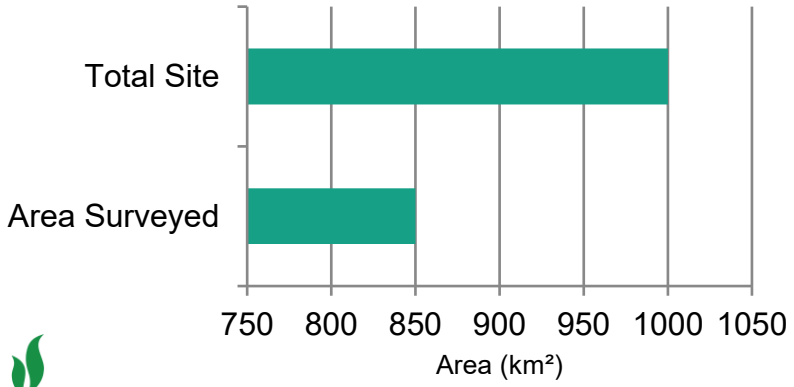
- Foundation location planning
- Cable route optimization
- Morphological change assessment
- Sediment transport modeling

Resolution: Typical 1-2m grid in 50m water depth

MBES is the "base map" for all geophysical and geotechnical planning



Typical MBES Coverage (km²)



Sub-Bottom Profiler (SBP)

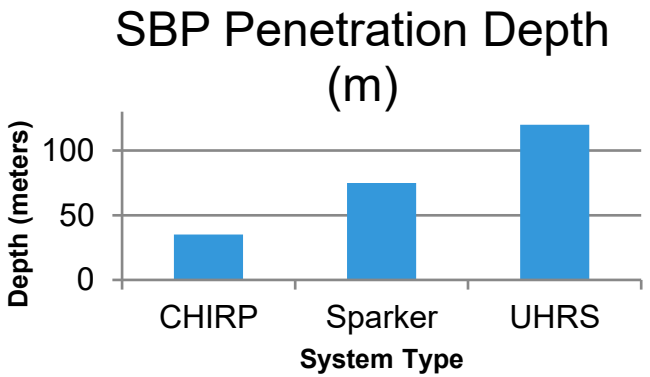
Shallow Geological Stratigraphy

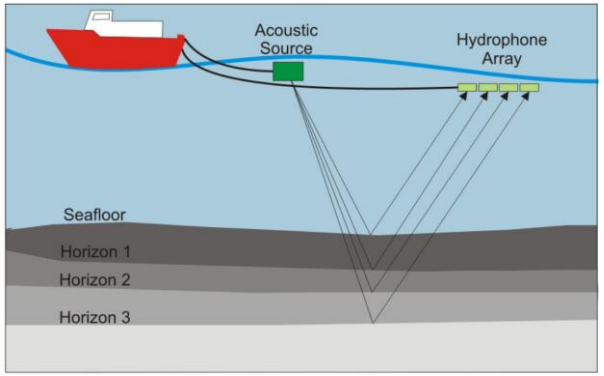
System Types & Penetration

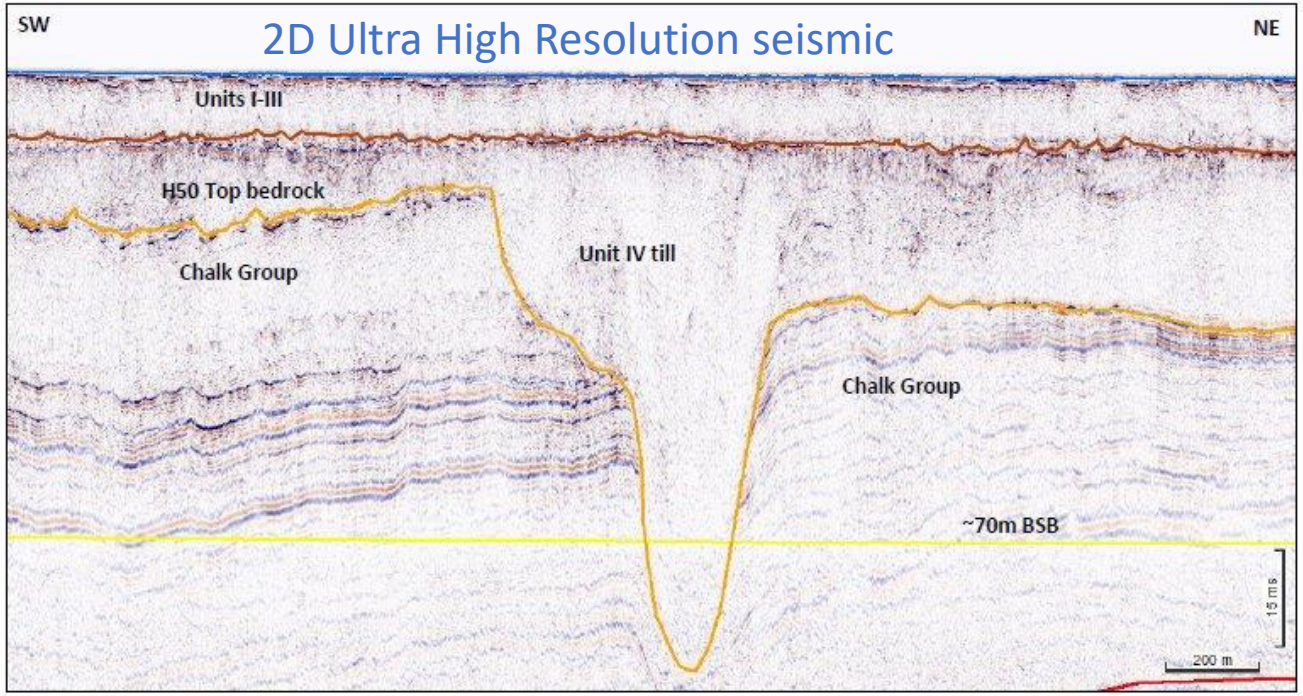
CHIRP (3.5 kHz): 20-50m, high resolution

Sparker/Boomer: 50-100m, moderate resolution

UHRS: 100m+, lower resolution







Critical Function

SBP data is used to plan where to place expensive boreholes and CPTs in Phase 3

Magnetometry for UXO Detection

Two-Stage Process

Phase 2: Reconnaissance

Line spacing: 250-500m

Identify high-risk areas

Phase 3: Detailed Clearance

Line spacing: <25m

High-resolution gradiometry

ROV investigation & clearance

Critical for Vietnam

Coastal waters, particularly near historical naval bases, may have significant UXO risk

Detection Method: Measures magnetic anomalies from ferrous objects

Post-Processing

Anomaly classification (high/medium/low risk)

The Integrated Ground Model

Where Geophysics Meets Geotechnics

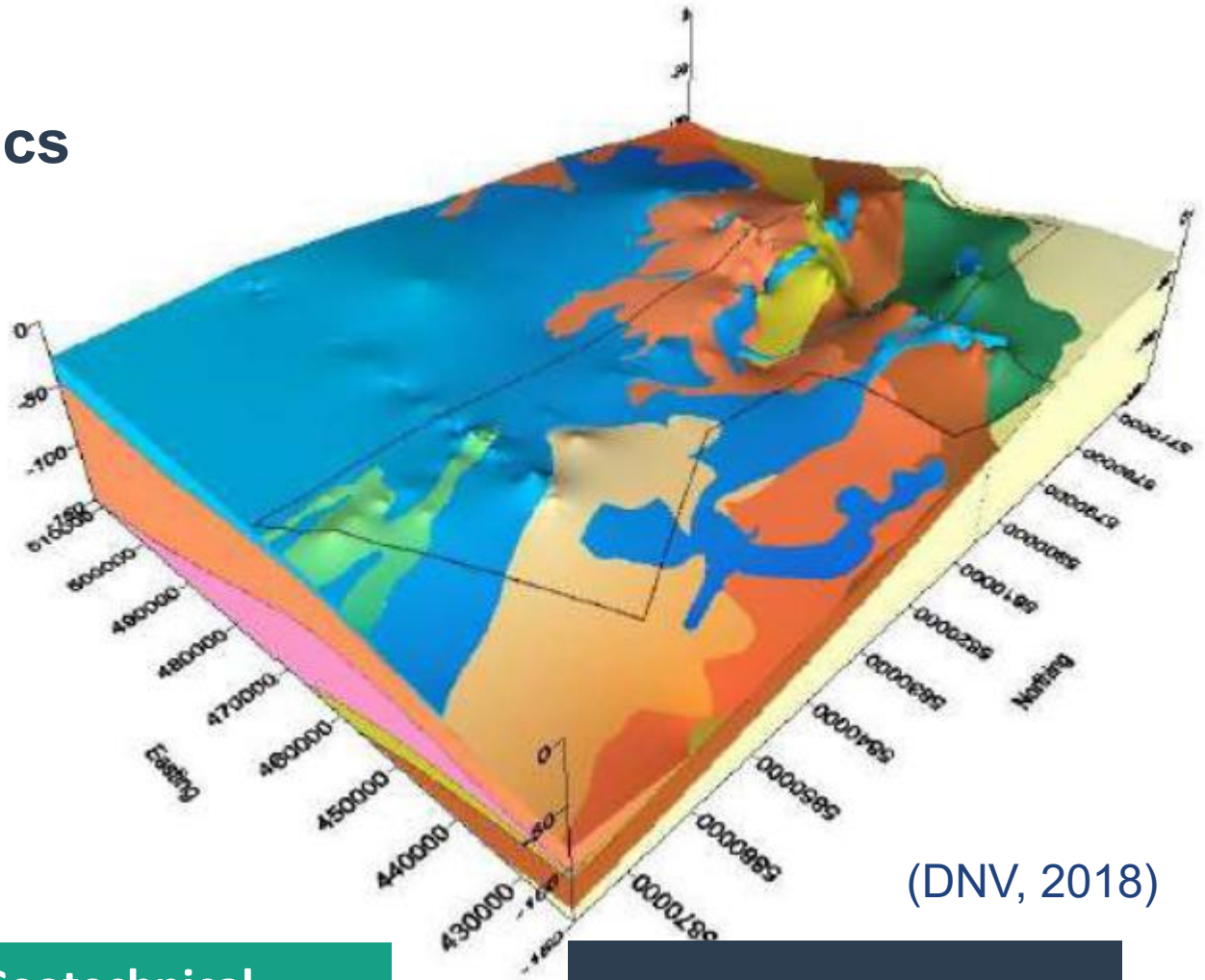
Geophysical Surveys
Tell you WHERE the layers are

+

Geotechnical Investigations
Tell you WHAT the layers are made of

=

Integrated 3D Ground Model
For design & construction



(DNV, 2018)

Geophysical Survey → **Geotechnical Investigation** → **3D Ground Model**

Phase 3: Detailed Geotechnical Investigation

Primary Investigation Methods

Cone Penetration Tests (CPT)
Continuous soil strength profiles

Seismic CPT (SCPT)
Adds shear wave velocity (Vs)

Geotechnical Boreholes
Physical samples for lab testing



International Standard
1 investigation
per foundation location

Depth: 50-70m
Cost: $10-25M

Cone Penetration Test (CPT)

The Workhorse of Offshore Geotechnics

Key Measurements

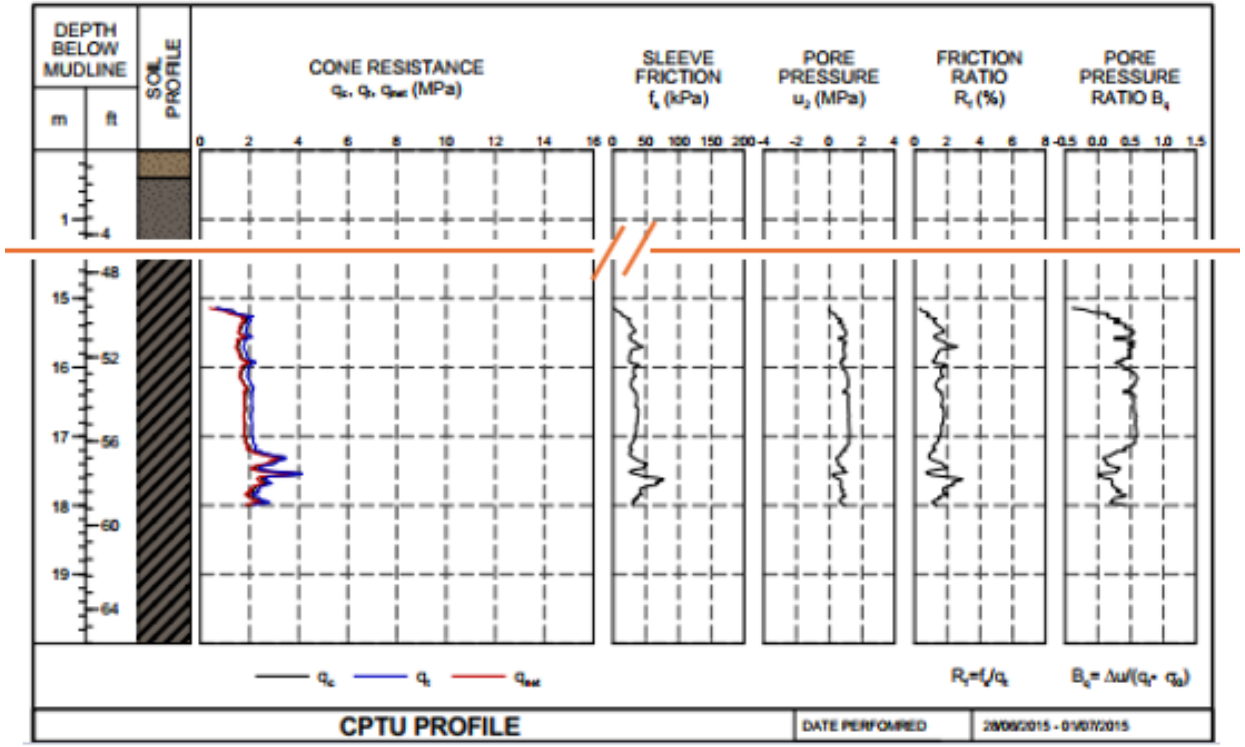
Tip Resistance (qc): Bearing capacity

Sleeve Friction (fs): Soil type

Pore Pressure (u): Drainage

SCPT adds: Shear wave velocity

Advantages: Fast, continuous, repeatable



Geotechnical Boreholes & Laboratory Testing

Borehole Program

Typical Depth: 50-70m per location

Frequency: 1 per 5-10 turbines

Purpose: Sample every geological layer

Why Sample?

CPTs give profiles, but boreholes provide actual physical samples for advanced laboratory testing

Laboratory Testing Suite

Classification: Grain size, Atterberg limits

Strength: Triaxial, direct shear

Dynamics: Cyclic triaxial for fatigue

Special: Consolidation, permeability

Critical for modeling 30 years of cyclic loading from wind and waves

Key Data Deliverables

Raw Data

XYZ, SEG-Y, ESRI Shapefiles, GeoTIFF

Processed Data

Bathymetric grids, seismic sections, hazard maps

Interpretations

Geological models, foundation recommendations

Marine Site Investigation Report

- Survey methodology
- Environmental conditions
- Seabed assessment
- Foundation capacity analysis
- Geohazard identification
- Engineering recommendations

Lesson from Denmark: State-Led De-risking Model

Danish Energy Agency (DEA) Process

Step 1: Strategic Environmental Assessment

Step 2: State conducts preliminary surveys

Step 3: Grid connection provided

Step 4: Data package FREE to all bidders

Result
€10/MWh
Low prices

Bidders compete on known conditions with lower risk

Denmark vs Vietnam: Risk Allocation Models

Vietnam Model

Developer-Led

- Developer funds ALL surveys ($20-40M)
- NO cost reimbursement if tender lost
- Data submitted to government
- 100% risk on developer

Result: Higher PPA bids (risk premium)

Denmark Model

State-Led De-risking

- State funds preliminary surveys
- 3D ground model provided FREE
- Data shared with all bidders
- State absorbs early risk

Result: Low PPA bids

The Critical "Timeline Squeeze"

The Conflict

Decree 58:

24 months

deadline for FS approval

VS

Survey Requirements:

12-month metocean survey
12-month environmental survey
= 18-24 months actual

The Problem

Parallel surveys + geotechnical =

IMPOSSIBLE in 24 months

Consequence

Forces massive at-risk investment

BEFORE investor selection

Applicable International Standards

Geophysical & Geotechnical

DNVGL-RP-C212
Offshore soil investigation

ISO 19901-8
Marine soil investigations

DNVGL-ST-0126
Support structures for wind turbines

NORSOK G-001
Marine soil investigations

Vietnamese Standards

20 new TCVN standards
(announced September 2025)

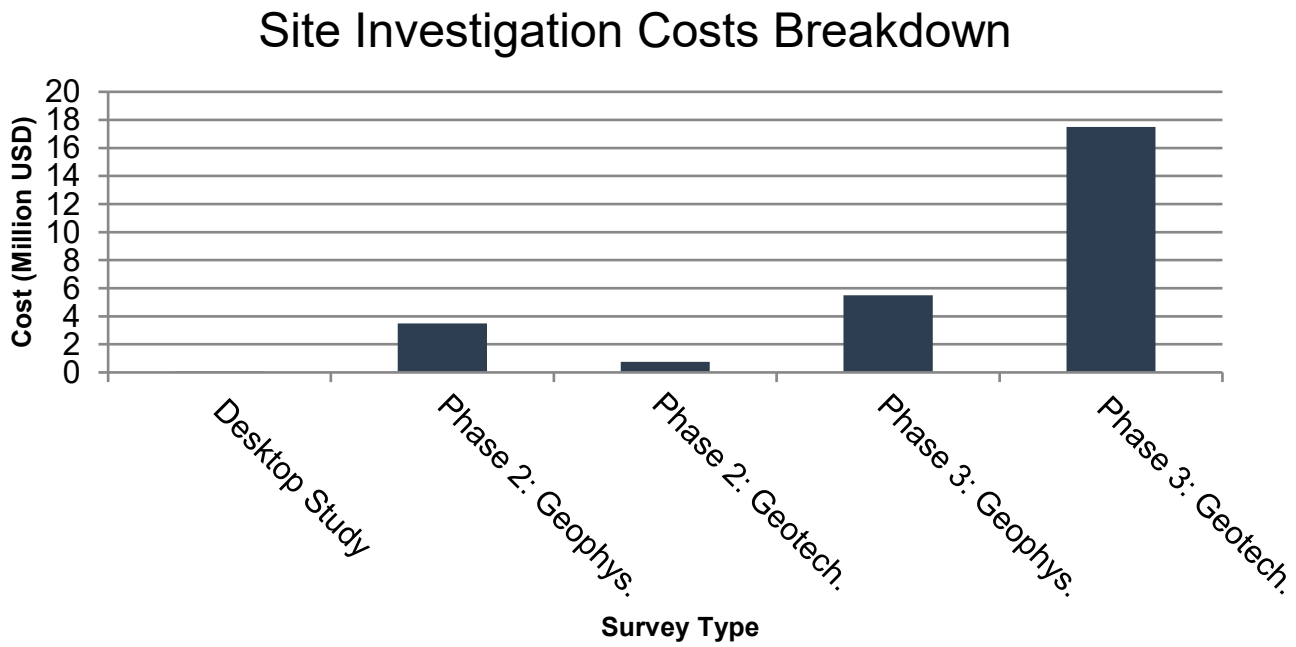
Critical Challenge

Harmonization between TCVN and IEC/ISO/DNV standards is essential

Why? To avoid "bankability gap" for international lenders

Investigation Costs & Timelines

For 1 GW Offshore Wind Farm



Total

$15-40M

12-24 months

Massive investment

https://guidetofloatingoffshorewind.com/wind-farm-costs/

Key Recommendations

1. Adopt Unified Technical Standards

Use the 3-phase framework as basis for official TCVN regulations. Ensure harmonization with IEC/DNV standards.

2. Implement SEA-First Approach

State conducts Strategic Environmental Assessment before site allocation to de-risk

3. Resolve Timeline Squeeze

Extend FS deadline to 36 months OR allow survey start before investor selection.

4. Consider State-Led De-risking (Long-term)

Pilot state-funded preliminary investigations in designated zones to achieve competitive PPA pricing.

Summary: Critical Success Factors

For Quality Site Investigation

- Adopt phased, international best-practice approach
- Require comprehensive geophysical/geotechnical integration
- Mandate adequate investigation at all foundation locations
- Ensure data quality through robust QA/QC

For Project Bankability

- Harmonize Vietnamese and international standards
- Provide regulatory certainty and timeline clarity
- Consider state-led de-risking for competitive pricing
- Learn from Denmark's proven model

Success requires both technical rigor and strategic policy decisions

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THANK YOU!

Open for Questions & Discussion

Building a Sustainable Offshore Wind Industry in Vietnam

