



WIND ENERGY

June 2020





ABOUT DK RENEWABLE ENERGY

Originating from Denmark – one of the world's leading countries in clean energy, *DK Engineering Ltd.* has been involved in renewable energy development for over 10 years. In South East Asia we offer development, design and full EPC capabilities for wind, solar and bio-waste energy projects alongside trusted partners



WHAT WE DO

At DK Renewable Energy we:

- Consultancy from project planning through to operation
- Pre-feasibility and feasibility studies
- LCOE calculations, technical design, bidding documents and evaluation
- Project construction, management and consultancy
- EPC BOP construction and management with selected partners



WHY CHOOSE DKE

- We take an honest and responsive approach to our work
- We work collaboratively with clients
- We provide on-going project support service



WIND POWER

Wind power involves converting wind energy into electricity by using wind turbines. It is one of the oldest-exploited energy sources by humans and today is the most seasoned and efficient energy of all renewable energies.

DKE is an international company coming from Denmark, a world leading country in wind energy production and wind turbine production. Established in Vietnam in 2004, DKE with a experienced management being in SEA for more than 25 years and the establishment of DKE in 2004 offer full EPMC capabilities of wind power project.

A photograph of a large white wind turbine in the foreground, with another smaller one visible in the distance. The background shows a mountain range under a sky with soft, colorful clouds. The image is partially framed by green and yellow geometric shapes on the left and top.

DK SERVICES

- Investment consultancy
- Documentation for wind power development plan
- Wind measurement consultant and EPC
- Pre-feasibility study, feasibility study, basic design
- Preparation of EIA, PPA, Grid connection, SCADA & metering agreement
- Simulation and estimation of energy production
- Bidding consultancy
- Project management and consultancy
- EPC for electrical and civil BOP

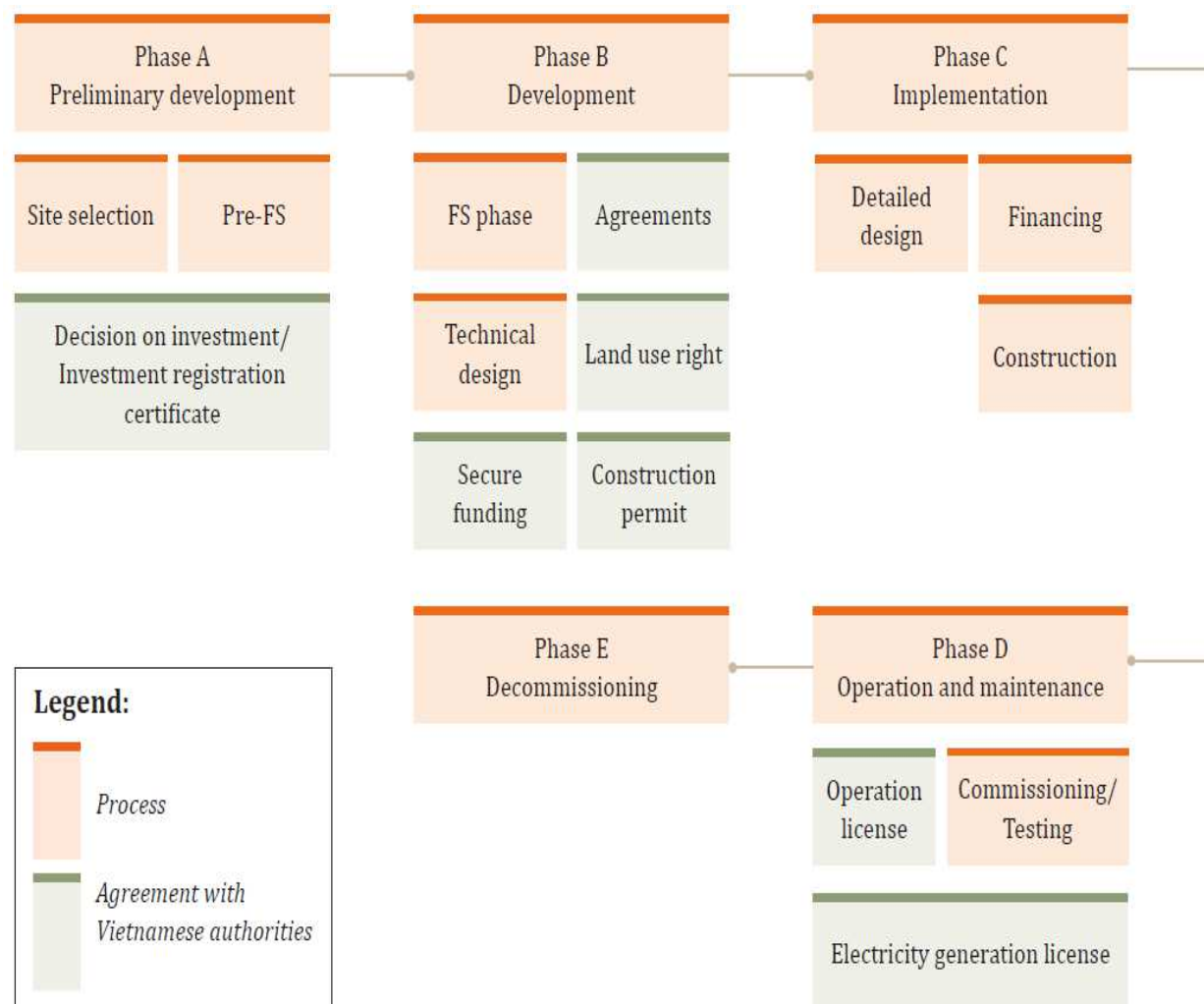


WIND POWER PROJECT DEVELOPMENT

What is wind power development process in Vietnam?

With GIZ support and our dedicated expert team experienced in working with Vietnamese authorities, DKE consult or represent investor to go through different steps needed in developing a wind farm in Vietnam:

- Preliminary development
- Project development
- Project implementation
- O&M
- Project lifetime, decommissioning



Overview of the wind power development project



SITE IDENTIFICATION/ SELECTION

At the beginning of the preliminary development process, DKE will support investor in locating a suitable site for project development. Some resources such as Wind Atlas of Vietnam onshore/ offshore, computer modeling, reference station and site visits will be used to shortlist a number of potential suitable sites and approach DOITs to check site availability and PWPDP



WIND RESOURCE ESTIMATION

The wind is essential fuel for wind power plant. Small changes in wind speed produce greater changes in the commercial value of a wind farm., Knowledge of the wind, therefore, is important for each and every stage of wind farm development, from initial site selection to operation.

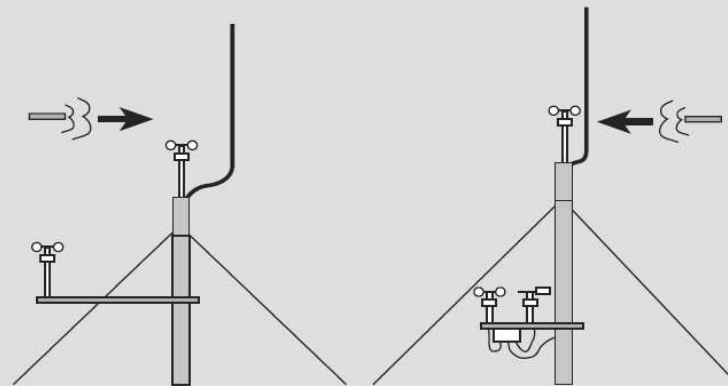
DK experience and accurate knowledge of wind resource will support investor to answer the questions:

- Where is it?
- What areas offer good potential?
- How is it measured?
- How will it change with time?
- How does it vary over the site?
- How is the harnessed?

WIND RESOURCE ESTIMATION

DK best practice for accurate wind speed measurements will provide information to allow the best possible on-site estimate of energy to be - offered. Based on project scale and site conditions, the number and height of Meteorological Masts will be designed and provided with monitoring equipment and required signals.

Summary of good practice (left) and poor practice (right) mounting arrangements (arrow indicates dominant wind direction)



Source: Garrad Hassan



PRE-FEASIBILITY STUDY

DKE provides Pre-FS report that helps investor assess his interest in developing the project as well as ensures sufficient accuracy when applying forth investment decision making.

- Pre-FS report shall include:
- Description of the project (size, energy generation, location, draft layout)
- Pre-design report
- High level estimation of project timeline
- Preliminary budget calculation, LCOE, payback time

In order to make decision on investment, we support investor to prepare documentation dossier for submission to MOIT



FEASIBILITY STUDY

Once investor obtains the investment registration certificate, he should elaborate a feasibility study for the project under development. This main milestone for project development will provide the investor with all necessary information to assess the practicality of a proposed project and setup required as well as document dossier to apply for the licenses/ agreements.

DKE is a recognized and certified consultant (Decree 59/2015/ND-CP) who can develop the feasibility study report.



TECHNICAL DESIGN

DK renewable energy engineering team with experience, profound knowledge of wind turbine generator and familiar with professional energy production prediction software will bring to investor the technical design with optimization of energy production.

Investor does not have to engage with any specific Wind Turbine suppliers but he can see what wind turbine is suitable for his project.



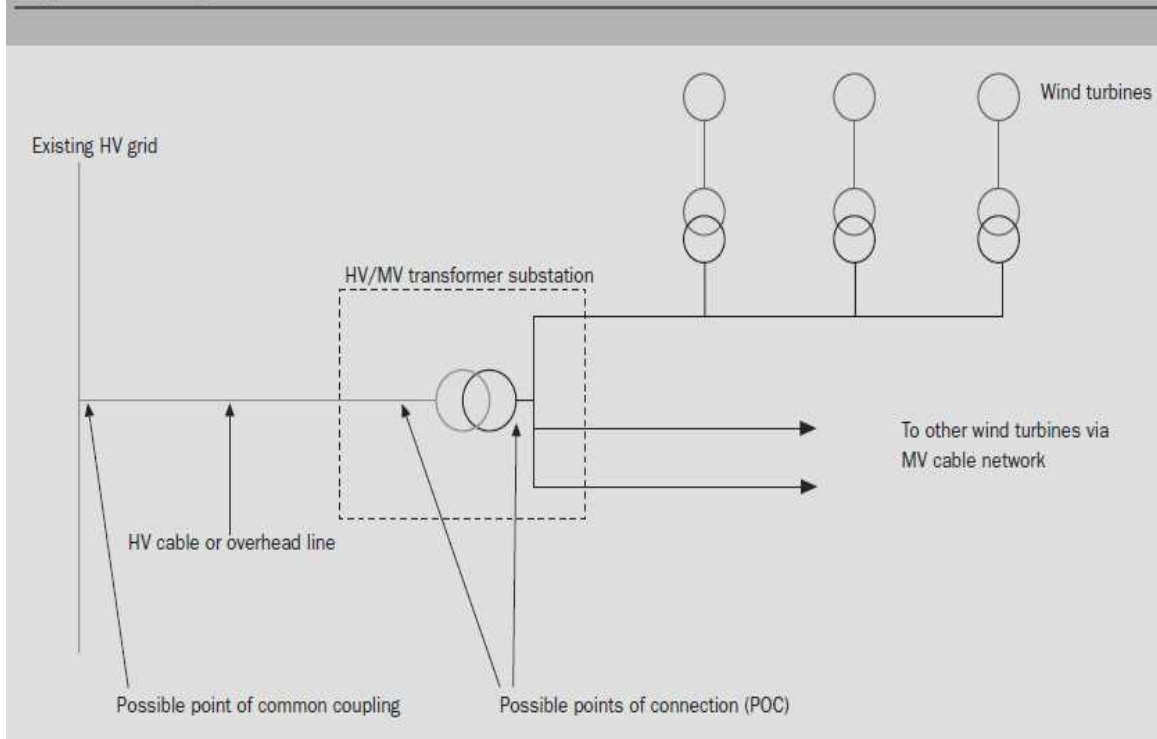
TECHNICAL DESIGN

- Architectural plan;
- Technology and specification of equipment and materials;
- Lifetime of the plant and its operation process and maintenance;
- Structural plan and major types of materials;
- Fire and explosion prevention and fighting plans;
- Environmental protection solutions;
- Cost estimate;
- Foreseen installed capacity;
- Site boundary;
- Detailed mapping for roads, dwellings, overhead lines, ownership boundaries;
- Environmental constraints and foreseen compensation measures;
- Noise and shadow flicker studies;
- Location of visually sensitive viewpoints;
- Turbine minimum spacing as defined by the turbine supplier;
- Constraints associated with communication signals;
- Logical diagrams of protection – control system and telecommunication system of the plan and substation.



- DKE also supports investor to obtain agreement/ approval from Vietnamese Authorities
- Grid connection agreement
- Metering agreement
- SCADA agreement
- Protection relay system agreement
- PPA
- PCCC approval
- EIA report

A typical electrical layout





BOP ENGINEERING, PROCUREMENT AND CONSTRUCTION

The civil and electrical works, often referred to as the “balance of plant” (BOP), is significant influence on the economic success of a wind farm.

DKE provides EPC services of the collector system, transmission line, transformer substation and grid connection including detailed engineering (circuits calculation, short-circuit current calculation, equipment specifications, electromechanical engineering, communication, control, protection and metering engineering, building engineering, etc.) geotechnical studies (soil studies and test in laboratories, etc.) and topography, including supply of "as built" drawings, documents and manuals, commissioning protocols and manuals. Vinaconex E&C - expert in heavy duty civil works is our partner for EPC of wind turbine foundation, internal road, O&M building.

With experience and knowledge about investor's needs, DKE & VEC JV creates valued engineering and delivers projects on schedule with high quality control and HSE management.



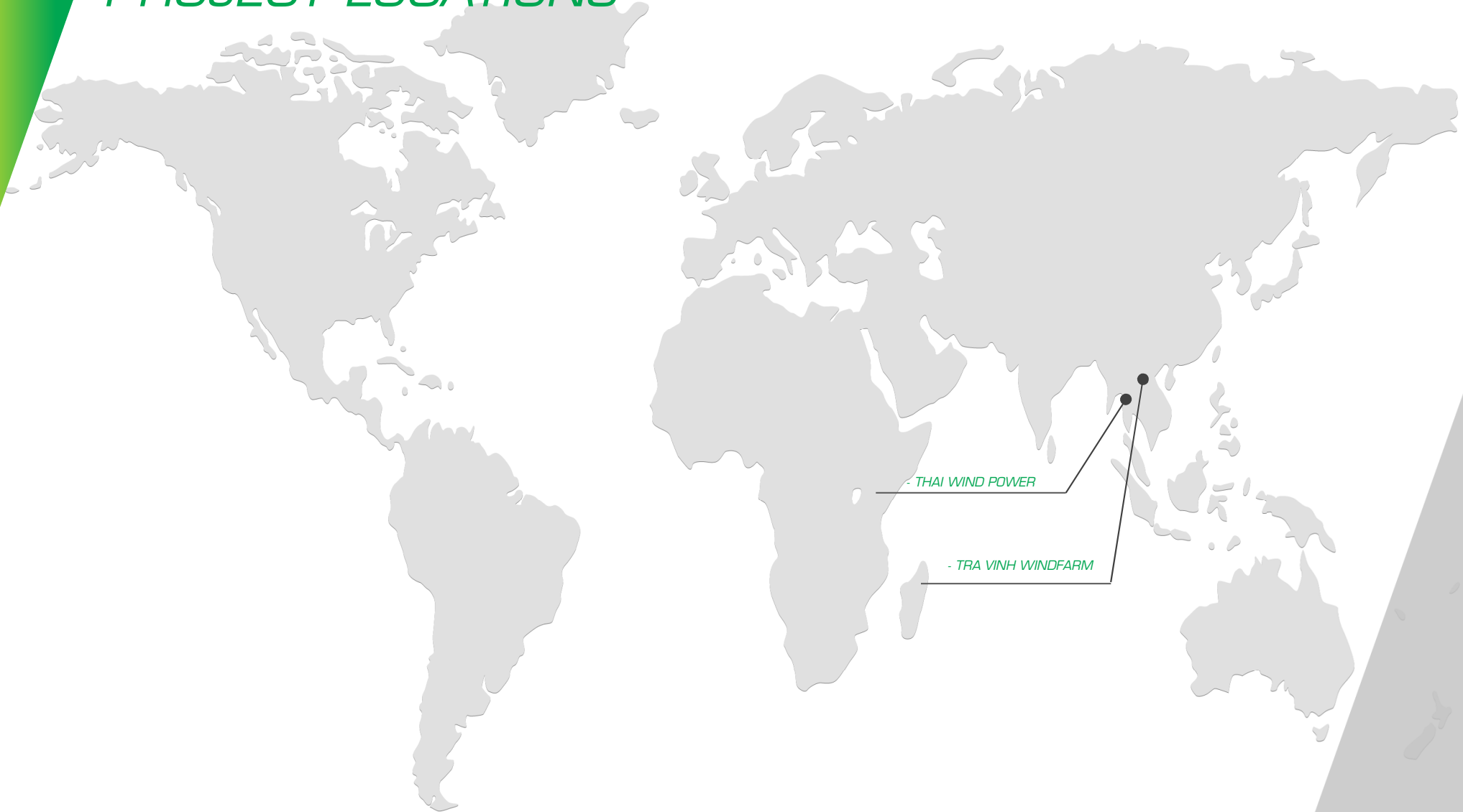
CLIENTS



Thai Windpower Co.,Ltd.

Vestas

PROJECT LOCATIONS



COMPANY LOCATION

SALES OFFICE
DK ENGINEERING LTD. (UNITED KINGDOM)

SALES OFFICE
DK ENGINEERING APS (DENMARK)

PROJECT OFFICE
PT D.K.E LIMITED (INDONESIA)

MANAGEMENT & CONSULTING
D.K.E LIMITED (HONG KONG)

RESOURCE BASE
DK ENGINEERING LTD (VIETNAM)

THANK YOU

VIETNAM

DK Engineering Ltd.

HITC Building, 239 Xuan Thuy Road
Cau Giay district, Hanoi, Vietnam

Klavs B. Nielsen

Phone: +84 24 37686 260

Fax: +84 24 37686 259

Mobile: +84 90403 7711

Email: kbn@dkengineeringltd.com

INDONESIA

PT DK Engineering

Menara Karya, 28th floor
Jl. H. R Rasuna Said Blok X-5 Kav. 1-2
Jakarta 12950 Indonesia

Dan S. Christensen

Phone: +62 21 5789 5530

Fax: +62 21 5789 5888

Mobile: +62 812322 16888

Email: dsc@dkengineeringltd.com

HONG KONG

D.K.E Limited.

3095 Two Exchange Square,
Suite No. 7537
8 Connaught Place, Central,
Hong Kong

Dan S. Christensen

Phone: +852 2522 1114

Fax: +852 2521 1190

Email: dsc@dkengineeringltd.com

UNITED KINGDOM

Lions & Tigers

Graham Davies

Phone: +44 0 79 2517 6329

Email: graham.davies@dkengineeringltd.com

DENMARK

DK Engineering ApS

Maren Finds Dalen 7, 1st Floor
Apartment No 7
Mariager - 9950
Denmark

Klavs B. Nielsen

Mobile: +84 90403 7711

Email: kbn@dkengineeringltd.com