



# National Institute of Wind Energy (NIWE)



## OFFSHORE WIND ENERGY

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**Group Head – Wind Resource Assessment & Offshore**

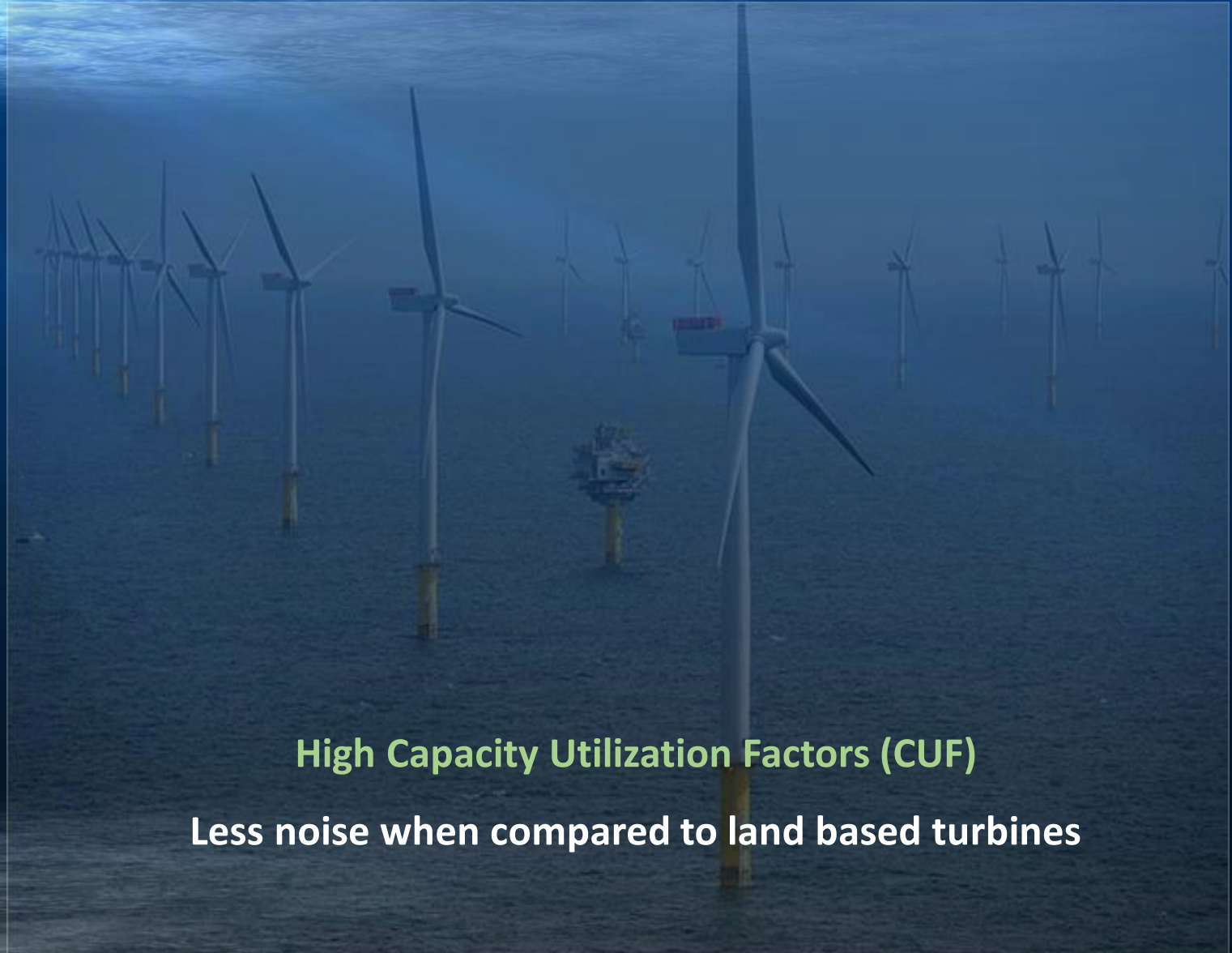
# Offshore Advantages

**Higher  
generation**

**Surfaces of seas  
are generally  
smooth.**

**Low Roughness**

**less turbulent  
and possesses  
high wind  
density**

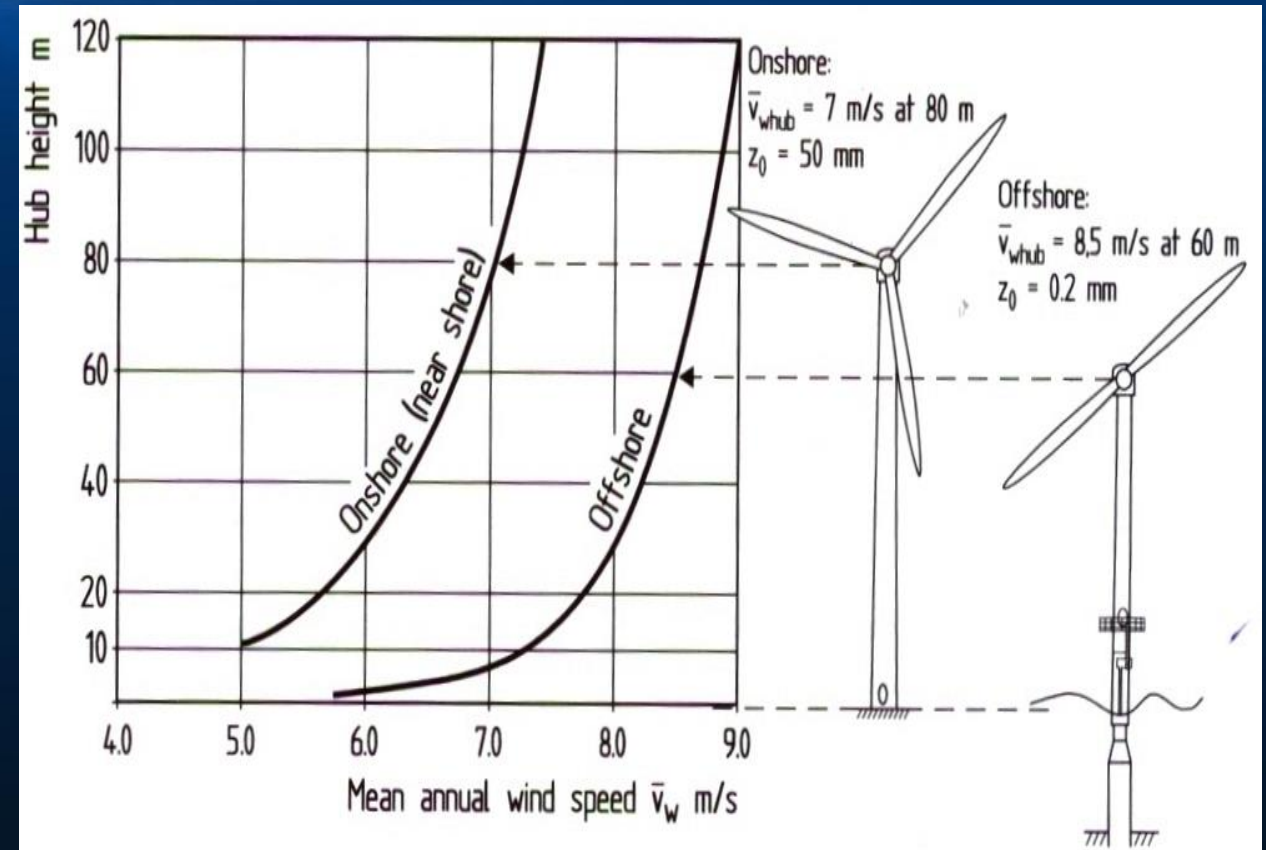


**High Capacity Utilization Factors (CUF)**

**Less noise when compared to land based turbines**

# Offshore Advantages

- Viable and proven technology
- Higher PLF than onshore wind farm – calm, steady and less turbulent wind flow
- Acquisition of Land, Logistic Management, Power Evacuation are challenges for the land based wind farms.



*Logarithmic profiles indicating increasing wind speeds with height for typical onshore and offshore wind turbines*

# Off-shore Global Scenario

- **World wide 14.3 GW offshore wind capacity installed**
- *Approximately equal capacity is under construction*
- **Asia Pacific Offshore installations:**

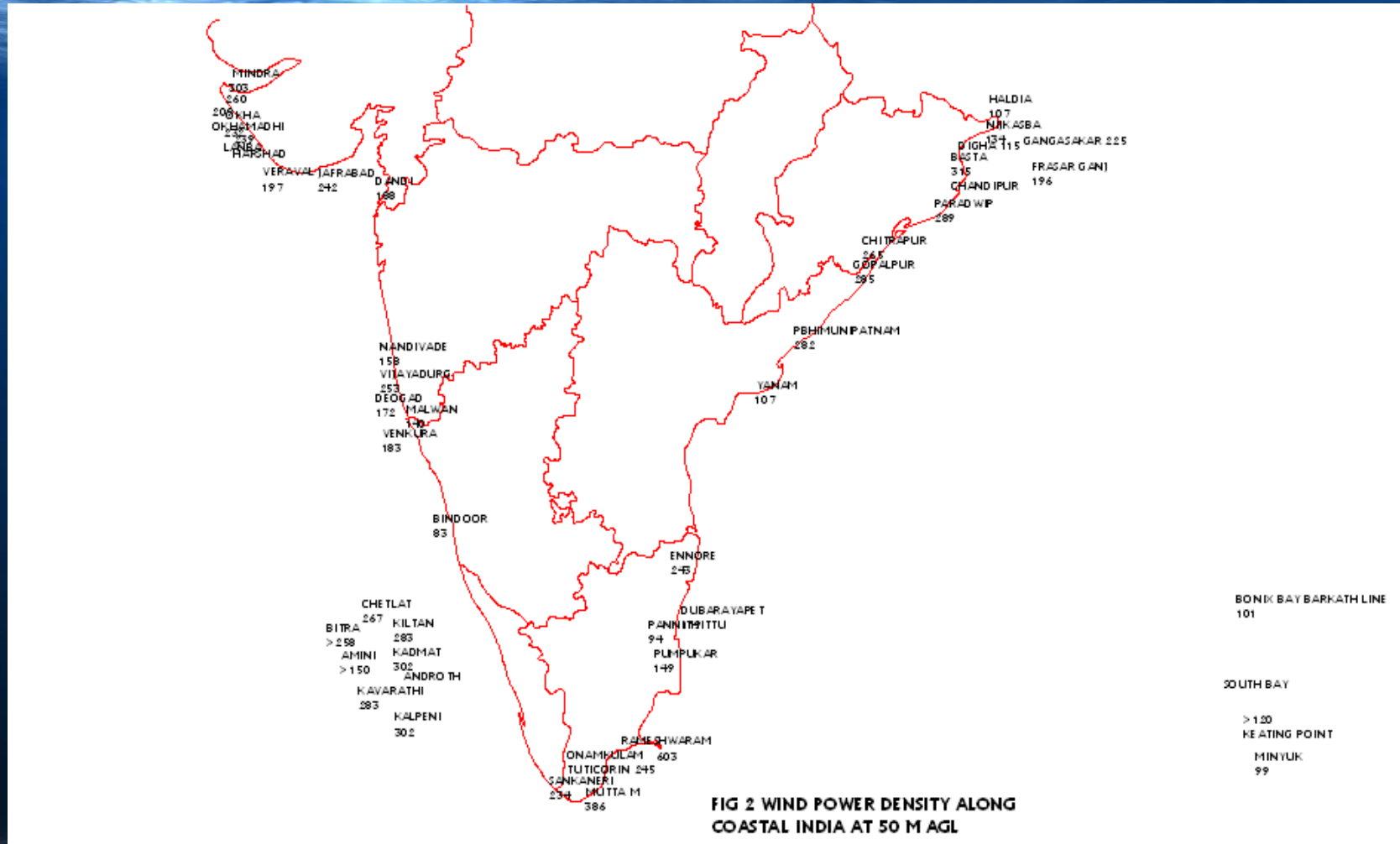


|    |                |          |
|----|----------------|----------|
| 1. | United Kingdom | 5156 MW  |
| 2. | Germany        | 4108 MW  |
| 3. | China          | 1627 MW  |
| 4. | Denmark        | 1271 MW  |
| 5. | Netherlands    | 1118 MW  |
| 6. | Belgium        | 712 MW   |
| 7. | Sweden         | 202 MW   |
| 8. | Others         | 190 MW   |
|    | TOTAL          | 14384 MW |

- JAPAN - 1 MW  
INSTALLED  
- 420 MW ARE UNDER  
CONSTRUCTION

- PLANS TO SET UP 1000  
MW OFFSHORE WIND  
FARMS

# Indian Efforts [ by MNRE/ NIWE ]

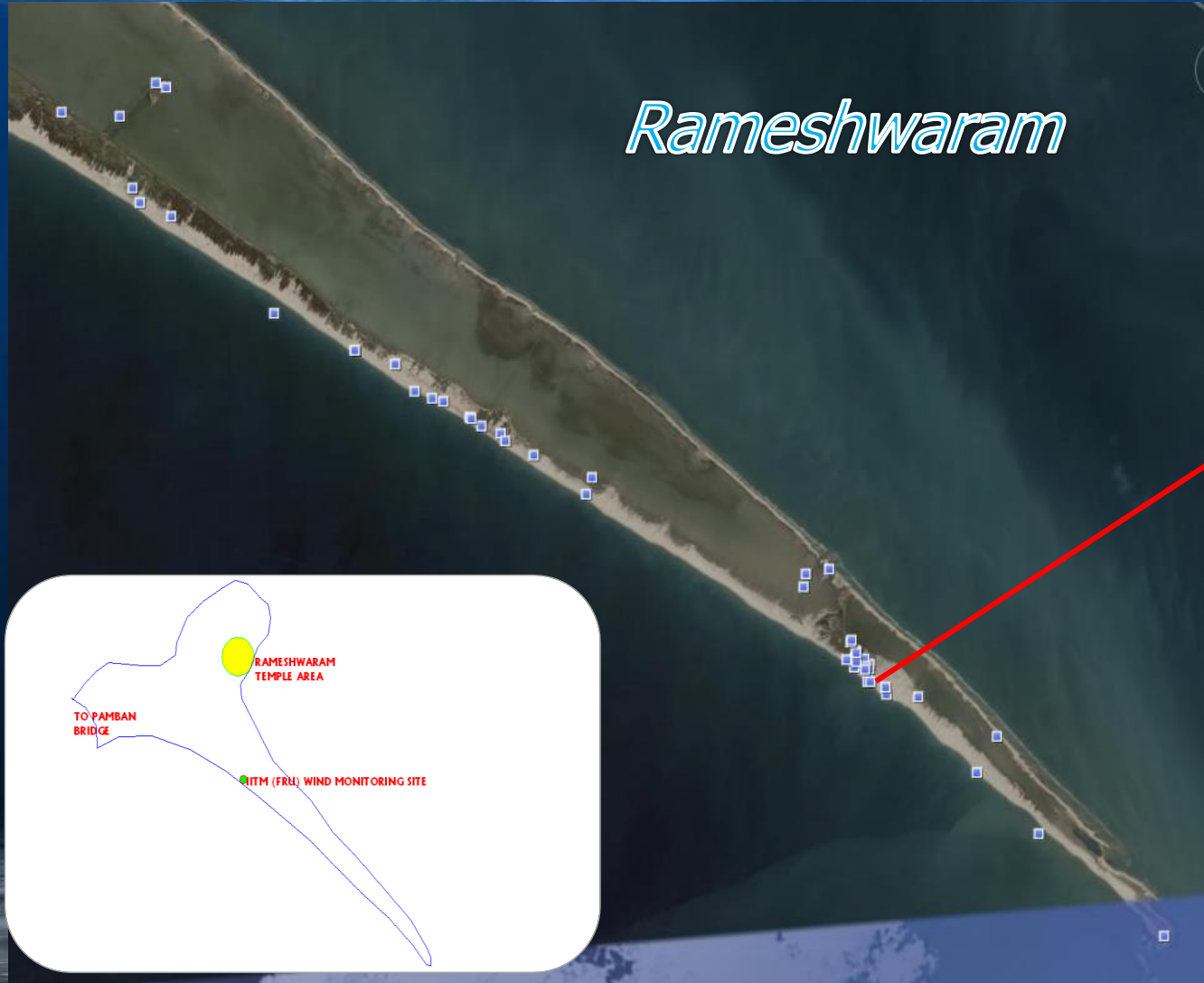


India is blessed a coast line of about 7600 kms.

Under national wind monitoring programme winds have been measured at 74 locations in the coast line

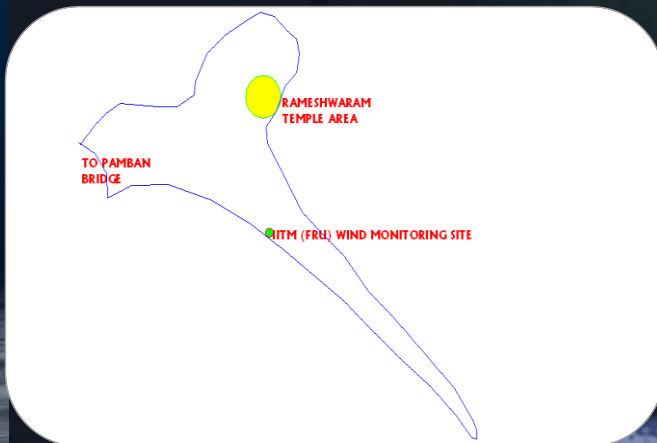
# Indian Efforts [by MNRE/ NIWE]

Wind power density (measure of power available in the wind) as  $603 \text{ W/m}^2$  at 50 m a.g.l.



*Rameshwaram*

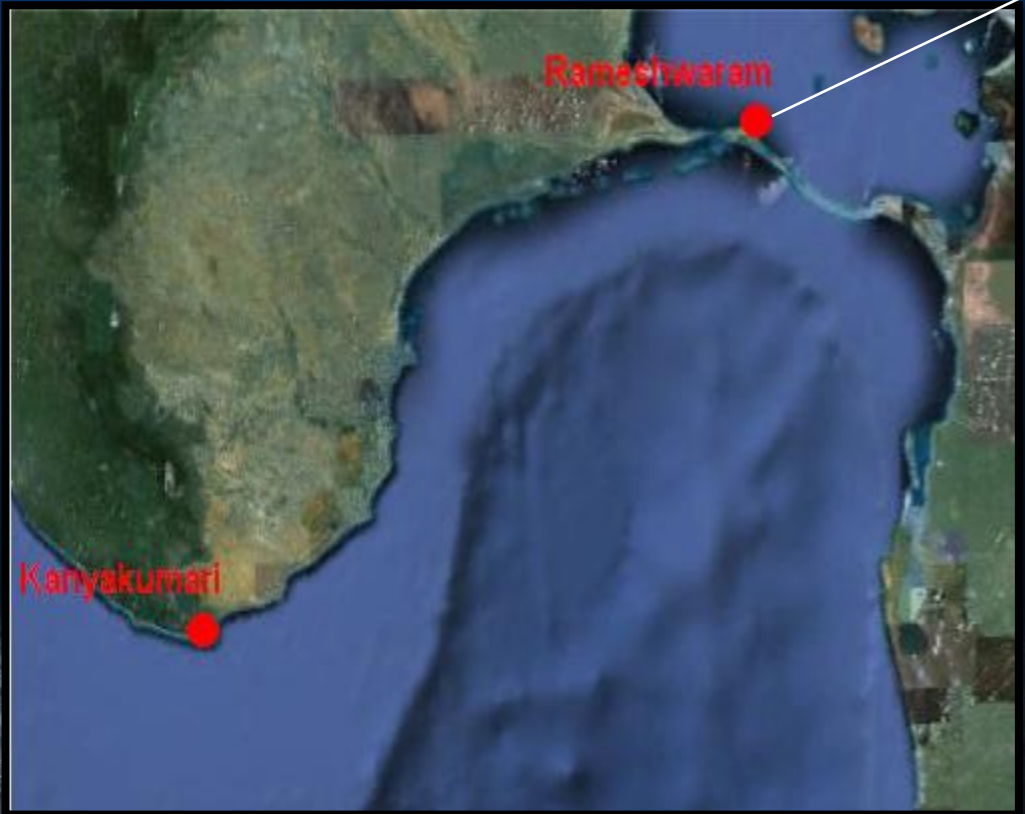
- *Narrow  
piece of land  
jutting  
towards  
Sri Lanka*



# Indian Efforts [ by MNRE/ NIWE ]

## Rameshwaram

NIWE has already installed a 100 m guyed mast at Rameshwaram, Ramanathapuram district in Tamil Nadu.



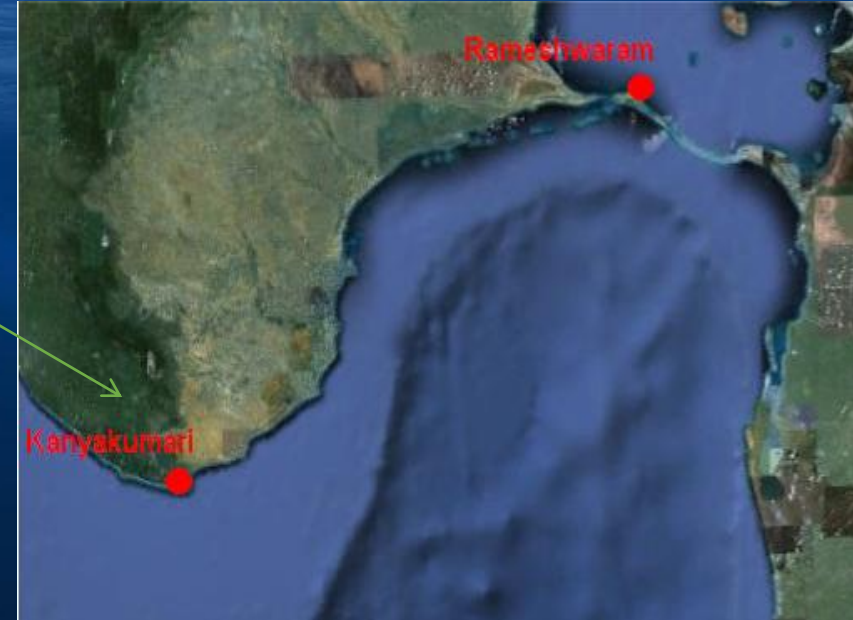
| Monthly Average Wind Speed at Rameshwaram at 100 m height (m/s) |               |
|-----------------------------------------------------------------|---------------|
| October 2015                                                    | 8.3457        |
| November 2015                                                   | 7.4629        |
| December 2015                                                   | 9.0546        |
| January 2016                                                    | 9.7545        |
| February 2016                                                   | 7.4781        |
| March 2016                                                      | 7.7169        |
| April 2016                                                      | 5.2374        |
| May 2016                                                        | 9.9044        |
| June 2016                                                       | 9.9286        |
| July 2016                                                       | 10.2385       |
| August 2016                                                     | 9.7407        |
| <b>Average</b>                                                  | <b>8.6238</b> |

# Indian Efforts [ by MNRE/ NIWE ]



## Kanyakumari

- WPD at Kanyakumari is in the range of  $370 \text{ W/m}^2$  at 30 m a.g.l.



- Nuclear Power Corporation Indian Ltd., Kudangulam, near Kanyakumari
- Proposed location for installing 2<sup>nd</sup> 100 m mast.

# Indian Efforts [ by MNRE/ NIWE]

## Gujarat / Goa / Karnataka / Kerala

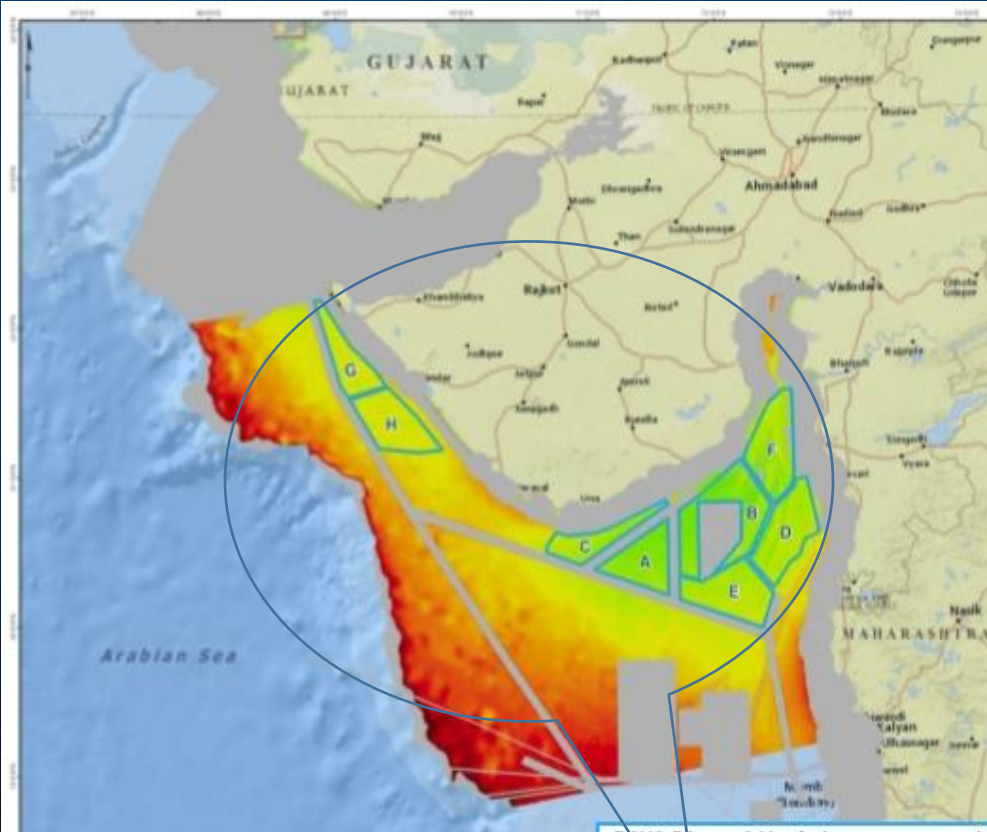
- Western Coast line has modest potential at sea level.
- Gujarat has reasonable potential but is prone to cyclonic conditions that can be very severe.
- Coastal areas in Kerala and Karnataka have shown marginal sites indicating that winds are rather poor in the first hundred meters.
- Elevated hills of Goa also exhibit similar trends
- One moves up northwards there is some improvement but it is not something that will attract offshore wind farming



# IDENTIFIED OFFSHORE WIND POTENTIAL ZONES

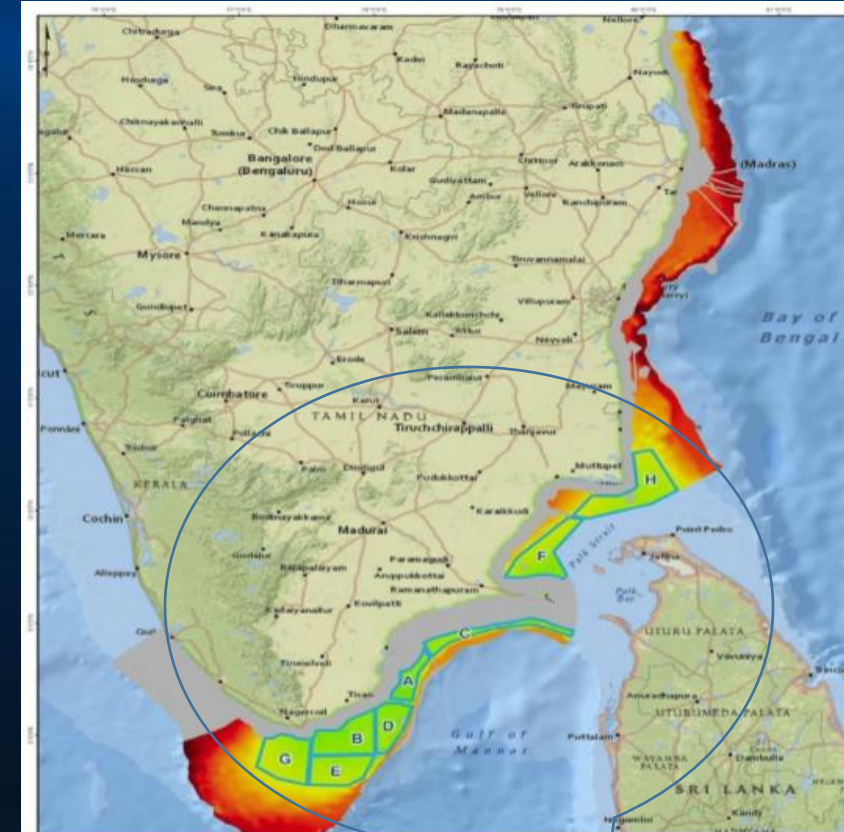
India has a coastline of - 7600 kms

8 zones identified both for Gujarat and Tamil Nadu



GUJARAT

Total area (A to H) = 17706 Sq.km



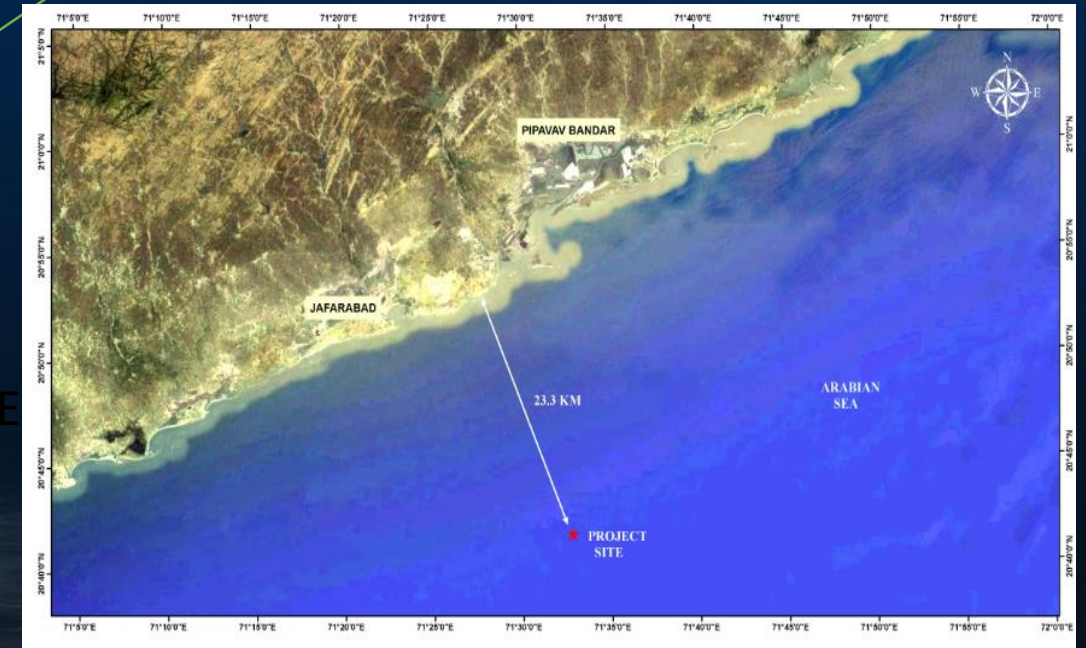
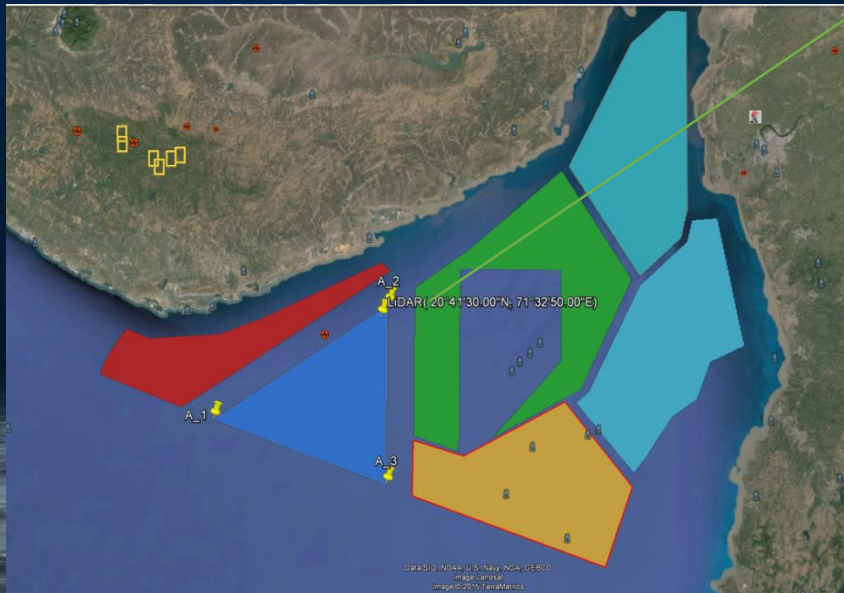
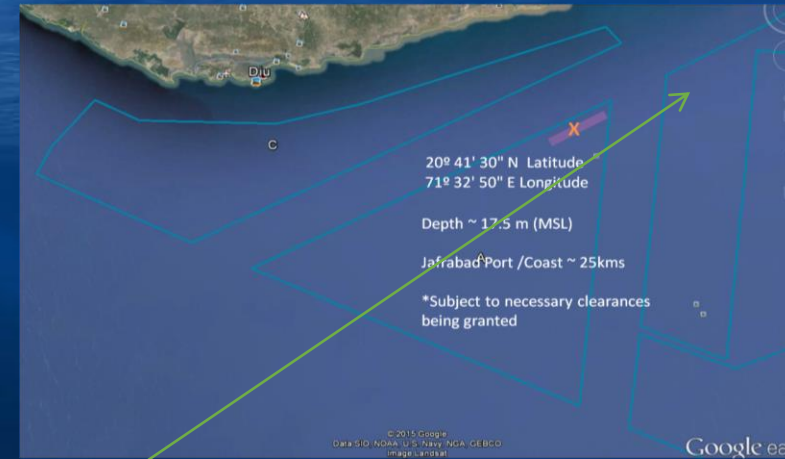
TAMIL NADU

Total area (A to H) = 10558 Sq.km

# Location of the offshore structure at Gujarat



- ❖ Location: Latitude  $20^{\circ} 41' 30''$  N  
Longitude:  $71^{\circ} 32' 50''$  E  
Village: Pipavav, Tehsil: Rajula  
District: Amreli
- ❖ Distance from the shore: 23 km
- ❖ CRZ classification of the zone : CRZ- IV  
as per CRZ notification 2011



# Location of the offshore structure at Gujarat



| Sl. No. |        | Latitude North | Longitude East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|----------------|-------------------------|
|         | Zone-A |                |                | 1,921                   |
| 1       | A_1    | 20.39243489    | 71.00247467    |                         |
| 2       | A_2    | 20.72821685    | 71.57147993    |                         |
| 3       | A_3    | 20.21484215    | 71.57147993    |                         |



| Sl. No. |        | Latitude North | Longitude East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|----------------|-------------------------|
|         | Zone-B |                |                | 2,924                   |
| 1       | B_1    | 20.31356438    | 71.80858696    |                         |
| 2       | B_2    | 20.35591954    | 71.66020473    |                         |
| 3       | B_3    | 20.77858661    | 71.65984332    |                         |
| 4       | B_4    | 21.11836035    | 72.13794098    |                         |
| 5       | B_5    | 20.81027519    | 72.37086712    |                         |
| 6       | B_6    | 20.49462566    | 72.2078889     |                         |
| 7       | B_7    | 20.3512001     | 71.91726437    |                         |
| 8       | B_8    | 20.57374373    | 72.14044563    |                         |
| 9       | B_9    | 20.83390609    | 72.1391539     |                         |
| 10      | B_10   | 20.83407181    | 71.80732725    |                         |



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# Location of the offshore structure at Gujarat



| Sl.No. |        | Latitude North | Longitude East | Area (Km <sup>2</sup> ) |
|--------|--------|----------------|----------------|-------------------------|
|        | Zone C |                |                | 1,414                   |
| 1      | C_1    | 20.51474592    | 70.62598998    |                         |
| 2      | C_2    | 20.56310546    | 70.64595508    |                         |
| 3      | C_3    | 20.64769737    | 70.7101286     |                         |
| 4      | C_4    | 20.62084794    | 70.78856291    |                         |
| 5      | C_5    | 20.63695817    | 71.01816153    |                         |
| 6      | C_6    | 20.8496884     | 71.54977754    |                         |
| 7      | C_7    | 20.82453255    | 71.57848728    |                         |



| Sl. No. |        | Latitude North | Longitude East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|----------------|-------------------------|
|         | Zone D |                |                | 2,547                   |
| 1       | D_1    | 20.2560653     | 72.38257482    |                         |
| 2       | D_2    | 20.45556476    | 72.19124264    |                         |
| 3       | D_3    | 20.48804274    | 72.23283659    |                         |
| 4       | D_4    | 20.79176505    | 72.39719213    |                         |
| 5       | D_5    | 20.91911129    | 72.55263467    |                         |
| 6       | D_6    | 20.98051119    | 72.56855921    |                         |
| 7       | D_7    | 20.98720781    | 72.65234131    |                         |
| 8       | D_8    | 20.62180088    | 72.74325381    |                         |
| 9       | D_9    | 20.57523217    | 72.63259409    |                         |
| 10      | D_10   | 20.46954608    | 72.58886102    |                         |
| 11      | D_11   | 20.41757165    | 72.50709919    |                         |



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# Location of the offshore structure at Gujarat



| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone E |                |                  | 2,503                   |
| 1       | E_1    | 19.98709564    | 72.29233427      |                         |
| 2       | E_2    | 20.18470016    | 71.6577294       |                         |
| 3       | E_3    | 20.34282578    | 71.66010619      |                         |
| 4       | E_4    | 20.30000218    | 71.82572143      |                         |
| 5       | E_5    | 20.45760545    | 72.15495539      |                         |
| 6       | E_6    | 20.21723576    | 72.37837433      |                         |
| 7.      | E_7    | 20.34282578    | 71.66058155      |                         |



| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone F |                |                  | 2,519                   |
| 1       | F_1    | 20.81776166    | 72.39760608      |                         |
| 2       | F_2    | 21.13084877    | 72.16052056      |                         |
| 3       | F_3    | 21.48665311    | 72.36373672      |                         |
| 4       | F_4    | 21.5807196     | 72.48138819      |                         |
| 5       | F_5    | 21.58005268    | 72.54912691      |                         |
| 6       | F_6    | 21.01807999    | 72.55554426      |                         |
| 7.      | F_7    | 20.92833871    | 72.53272701      |                         |



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# Location of the offshore structure at Gujarat



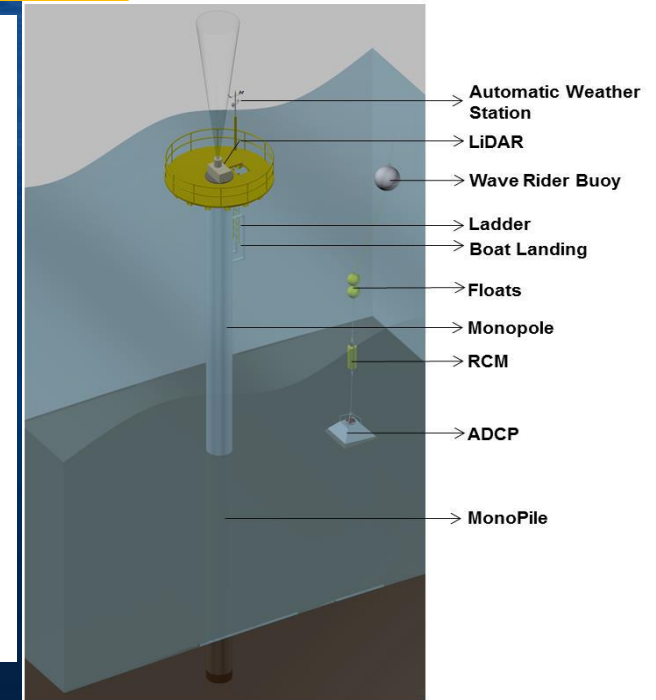
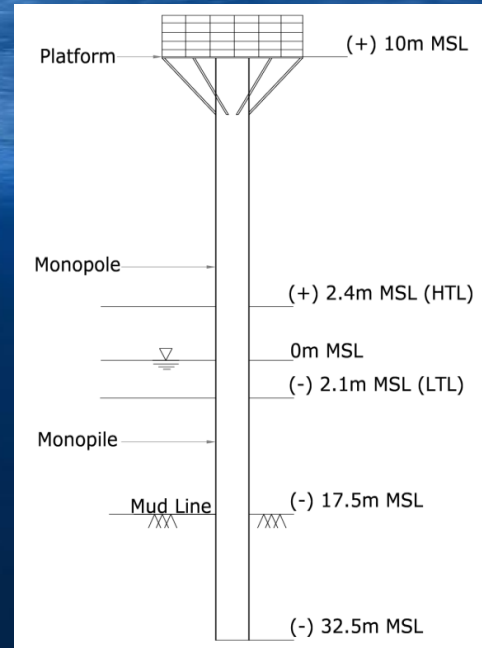
| Sl. No. | Zones  | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone G |                |                  | 1,624                   |
| 1       | G_1    | 21.55618308    | 69.10222293      |                         |
| 2       | G_2    | 21.63384921    | 69.39962563      |                         |
| 3       | G_3    | 21.74411849    | 69.30189172      |                         |
| 4       | G_4    | 21.89946961    | 69.11745226      |                         |
| 5       | G_5    | 22.20965761    | 68.88452612      |                         |
| 6       | G_6    | 22.20080466    | 68.83508874      |                         |
| 7       | G_7    | 21.62318206    | 69.04453212      |                         |



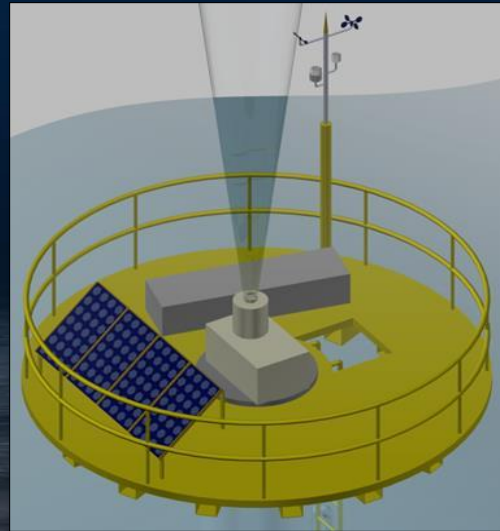
| Sl.No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|--------|--------|----------------|------------------|-------------------------|
|        | Zone H |                |                  | 2,254                   |
| 1      | H_1    | 21.20355861    | 69.83237505      |                         |
| 2      | H_2    | 21.18617237    | 69.65268918      |                         |
| 3      | H_3    | 21.2142568     | 69.33609978      |                         |
| 4      | H_4    | 21.54150759    | 69.1107794       |                         |
| 5      | H_5    | 21.62287092    | 69.41149179      |                         |

## Substructure details

- ❖ Monopile of 1.2 m diameter – 25 mm thickness
- ❖ Total pile length – 47.5 m
- ❖ Platform Dia – 5 m



Conceptual layout of Sub-structure for mounting LIDAR

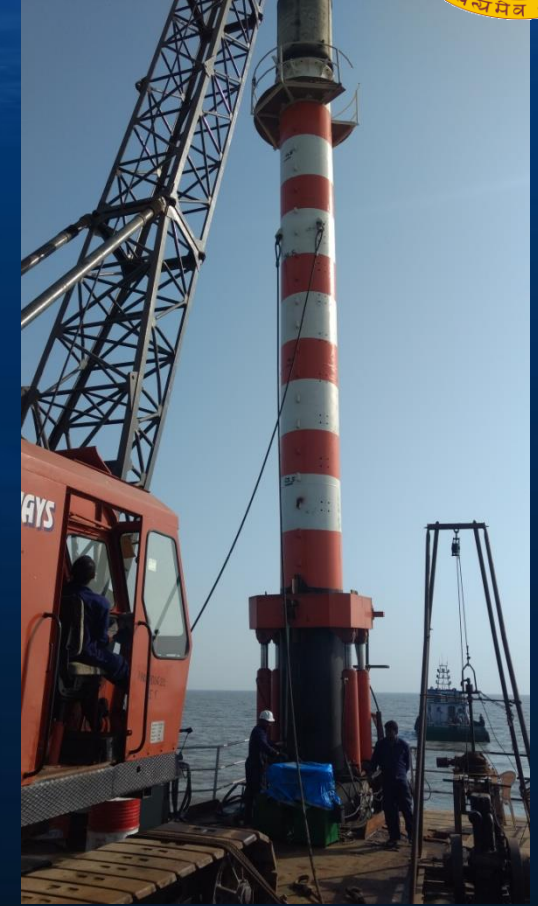
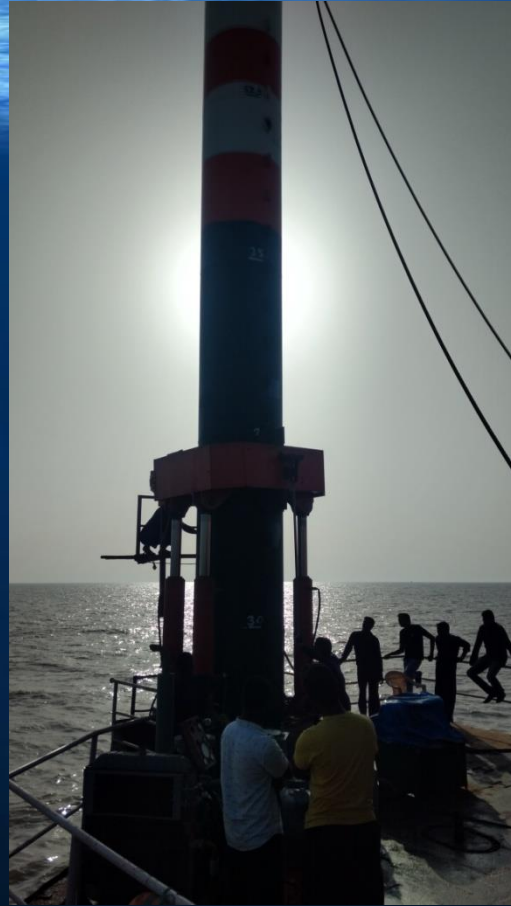


## Erection of substructure at Vessel / Barge



Installation and Commissioning of offshore sub-structure – Jan 2017

## Installation of substructure at Gulf of Khambat, Gujarat



Installation and Commissioning of offshore sub-structure – March 2017

## Installation of substructure at Gulf of Khambhat, Gujarat



Installation and Commissioning of offshore sub-structure – March 2017

## Installation of substructure at Gulf of Khambhat, Gujarat



Installation and Commissioning of offshore sub-structure – March 2017

## Installation of substructure at Gulf of Khambhat, Gujarat



[First Offshore Wind Monitoring Station video](#)

Installation and Commissioning of offshore sub-structure – March 2017



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## Reanalysis at LiDAR Location, Gujarat



- NIWE has done Reanalysis with the help of MERRA / ERA data
- Annual Energy Production (AEP) calculation has been done with various offshore turbines available in the market

| S.No | Make     | WTG rating<br>(MW) | Rotor<br>Diameter (m) | Hub Height<br>(m) | IEC 61400-3 |
|------|----------|--------------------|-----------------------|-------------------|-------------|
| 1    | Gamesa   | 5.00               | 128                   | 100               | Class 1B    |
| 2    | Sinovel  | 6.00               | 128                   | 100               | -           |
| 3    | RE power | 6.20               | 126                   | 100               | -           |
| 4    | Vestas   | 3.00               | 112                   | 100               | Class 1B    |

| Wind Profile<br>levels | Units | Jan  | Feb  | Mar  | Apr  | May  | Jun  | Jul   | Aug   | Sep  | Oct  | Nov  | Dec  | All  |
|------------------------|-------|------|------|------|------|------|------|-------|-------|------|------|------|------|------|
| 10                     | m/s   | 2.81 | 3.01 | 3.79 | 5.79 | 7.98 | 8.57 | 9.35  | 8.84  | 6.99 | 4.17 | 2.54 | 3.22 | 5.60 |
| 25                     | m/s   | 4.23 | 4.22 | 4.96 | 6.24 | 8.35 | 8.96 | 9.84  | 9.30  | 7.26 | 4.79 | 3.90 | 4.72 | 6.41 |
| 50                     | m/s   | 5.32 | 5.15 | 5.87 | 6.58 | 8.62 | 9.25 | 10.22 | 9.65  | 7.47 | 5.26 | 4.95 | 5.86 | 7.03 |
| 75                     | m/s   | 5.96 | 5.70 | 6.40 | 6.78 | 8.78 | 9.43 | 10.44 | 9.86  | 7.59 | 5.53 | 5.56 | 6.54 | 7.39 |
| 100                    | m/s   | 6.39 | 6.08 | 6.79 | 6.96 | 8.91 | 9.55 | 10.60 | 10.01 | 7.69 | 5.73 | 5.97 | 6.98 | 7.65 |
| 150                    | m/s   | 6.81 | 6.48 | 7.41 | 7.54 | 9.20 | 9.75 | 10.81 | 10.23 | 7.88 | 6.00 | 6.21 | 7.35 | 7.98 |
| 200                    | m/s   | 6.74 | 6.48 | 7.63 | 7.86 | 9.42 | 9.92 | 10.99 | 10.49 | 8.07 | 6.05 | 6.26 | 7.41 | 8.12 |

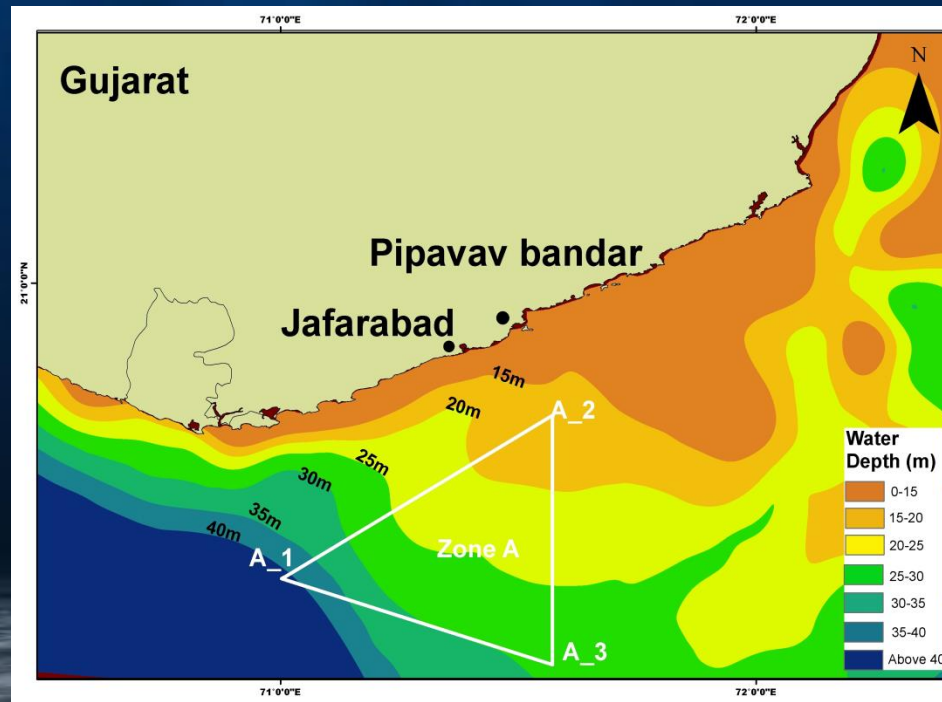
# Annual Energy Production

| Month   | Net Energy (kWh)                    |                                       |                                    |                                         |
|---------|-------------------------------------|---------------------------------------|------------------------------------|-----------------------------------------|
|         | Gamesa G128-5 MW Offshore<br>(100m) | Sinovel SL6000/128 Offshore<br>(100m) | REpower 6.2M126 Offshore<br>(100m) | Vestas V112 - 3.0 MW Offshore<br>(100m) |
| Jan     | 767,657                             | 717,579                               | 767,619                            | 582,006                                 |
| Feb     | 637,062                             | 592,498                               | 633,755                            | 483,827                                 |
| Mar     | 903,810                             | 868,829                               | 921,029                            | 681,531                                 |
| Apr     | 960,450                             | 941,934                               | 993,360                            | 716,000                                 |
| May     | 1,589,039                           | 1,640,575                             | 1,705,449                          | 1,152,437                               |
| Jun     | 1,728,022                           | 1,823,600                             | 1,886,677                          | 1,231,424                               |
| Jul     | 2,200,557                           | 2,356,054                             | 2,424,719                          | 1,557,409                               |
| Aug     | 1,993,582                           | 2,102,893                             | 2,171,951                          | 1,428,173                               |
| Sep     | 1,097,800                           | 1,082,825                             | 1,142,383                          | 815,446                                 |
| Oct     | 556,859                             | 505,500                               | 544,698                            | 424,269                                 |
| Nov     | 609,447                             | 557,401                               | 600,381                            | 466,116                                 |
| Dec     | 970,971                             | 941,101                               | 993,671                            | 729,958                                 |
| Overall | 14,015,218                          | 14,130,815                            | 14,785,722                         | 10,268,590                              |
| Per MW  | 2,803,044                           | 2,355,136                             | 2,384,794                          | 3,422,863                               |
| CUF %   | 32%                                 | 27%                                   | 27%                                | 40%                                     |

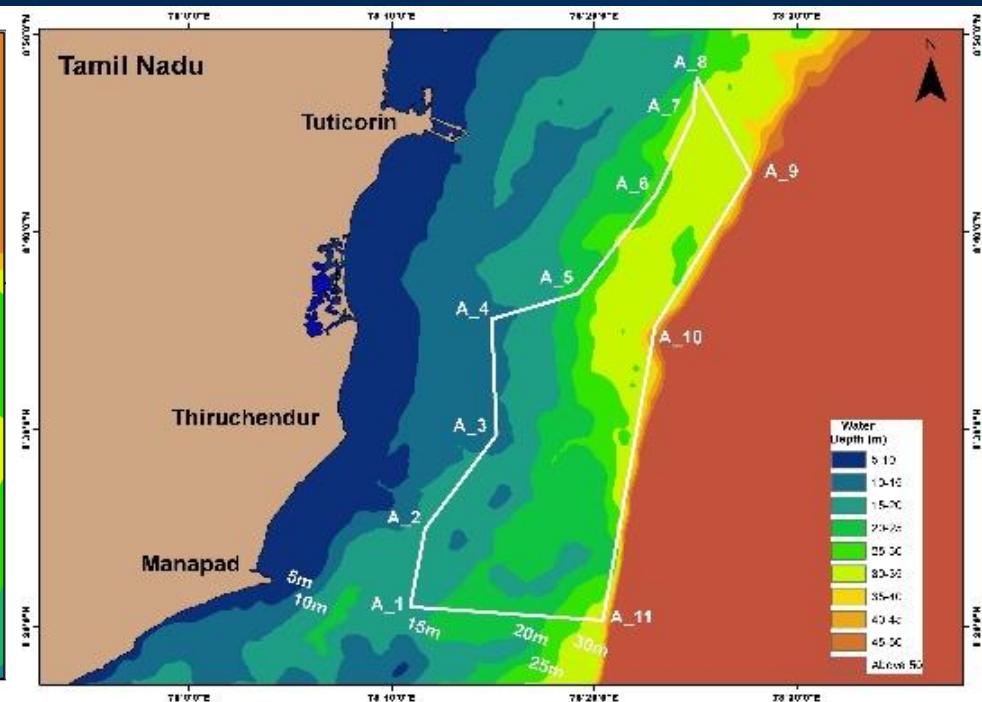
Note : Applied standard correction Factors (Machine & Grid availability - 95%, Transmission loss- 5%)

# Geophysical and Geotechnical studies off Gujarat and Tamil Nadu coasts

- To better understand the subsea profile data.
- Varying water depths ranging between 15 to 35 meters.
- Continuous Cone Penetration Test to be carried out.
- Friction offered from the sub-surface soil and the tip resistance to be plotted.
- Study will provide useful pointers for designing the offshore wind turbine foundations.

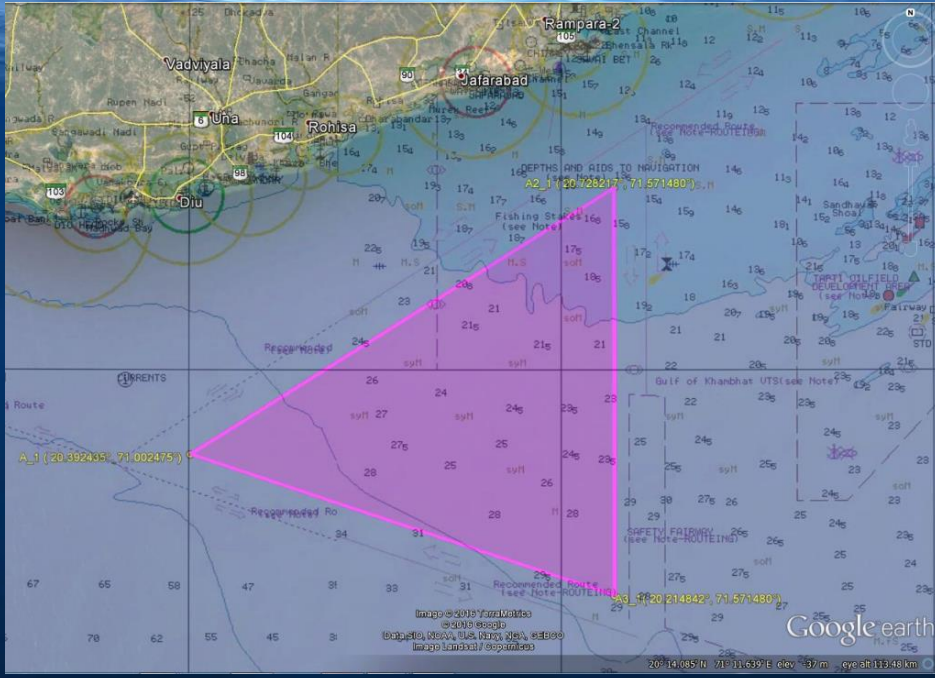


Gujarat



Tamil Nadu

# Geophysical and Geotechnical studies



ENC Chart for Gujarat coast



ENC Chart for Tamil Nadu coast



## FUTURE PLANS

### 1. Installation of LiDAR based offshore wind measurements Gulf of Mannar, Near Tuticorin, Tamil Nadu

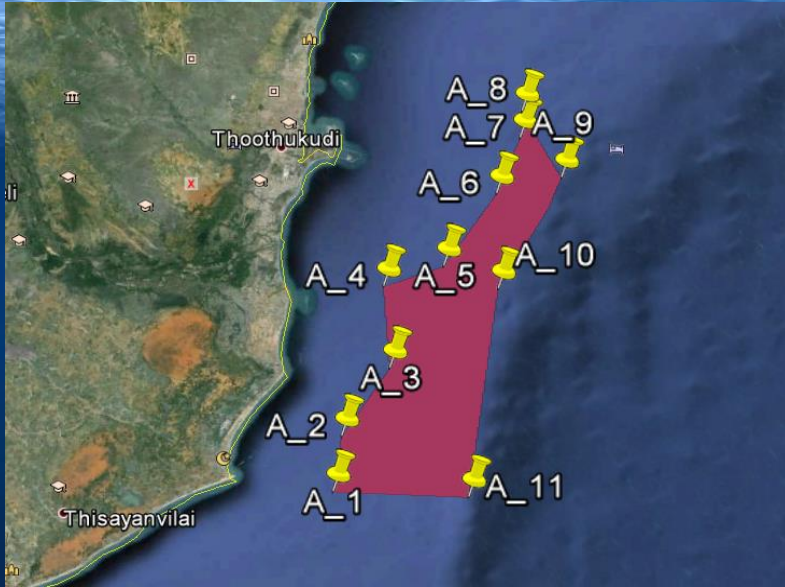


- LiDAR procurement underway
- Central level clearances obtained – MoD, MEA, MHA and Dos
- State level clearances underway – TMB, TNSCZMA
- Design of sub-structure (monopile & platform) completed



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# Location of the offshore structure at TAMIL NADU

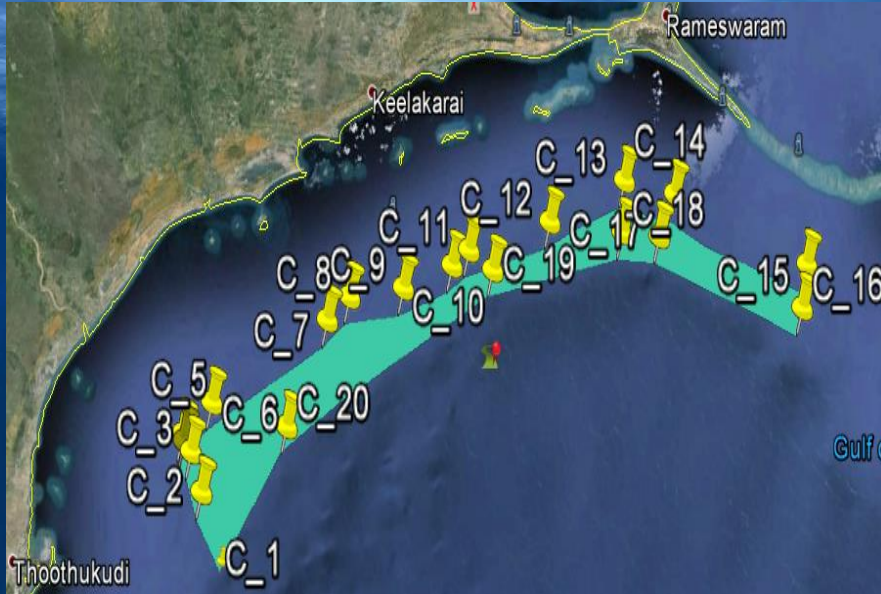


| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone A |                |                  | 588                     |
| 1       | A_1    | 8.35016539     | 78.18180888      |                         |
| 2       | A_2    | 8.41609179     | 78.194089        |                         |
| 3       | A_3    | 8.4956049      | 78.25303357      |                         |
| 4       | A_4    | 8.59342804     | 78.24892912      |                         |
| 5       | A_5    | 8.61530919     | 78.32023304      |                         |
| 6       | A_6    | 8.6998648      | 78.38500076      |                         |
| 7       | A_7    | 8.76563925     | 78.41479391      |                         |
| 8       | A_8    | 8.79732217     | 78.41812143      |                         |
| 9       | A_9    | 8.71669084     | 78.4618545       |                         |
| 10      | A_10   | 8.58645658     | 78.38328206      |                         |
| 11      | A_11   | 8.33864526     | 78.34049971      |                         |
| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|         | Zone B |                |                  | 1555                    |
| 1       | B_1    | 7.84427964     | 77.61085464      |                         |
| 2       | B_2    | 7.98372214     | 77.6202826       |                         |
| 3       | B_3    | 8.06190201     | 77.64523897      |                         |
| 4       | B_4    | 8.06641861     | 77.80779606      |                         |
| 5       | B_5    | 8.16056841     | 77.88266517      |                         |
| 6       | B_6    | 8.25824728     | 78.06449016      |                         |
| 7       | B_7    | 7.8599222      | 78.07005187      |                         |



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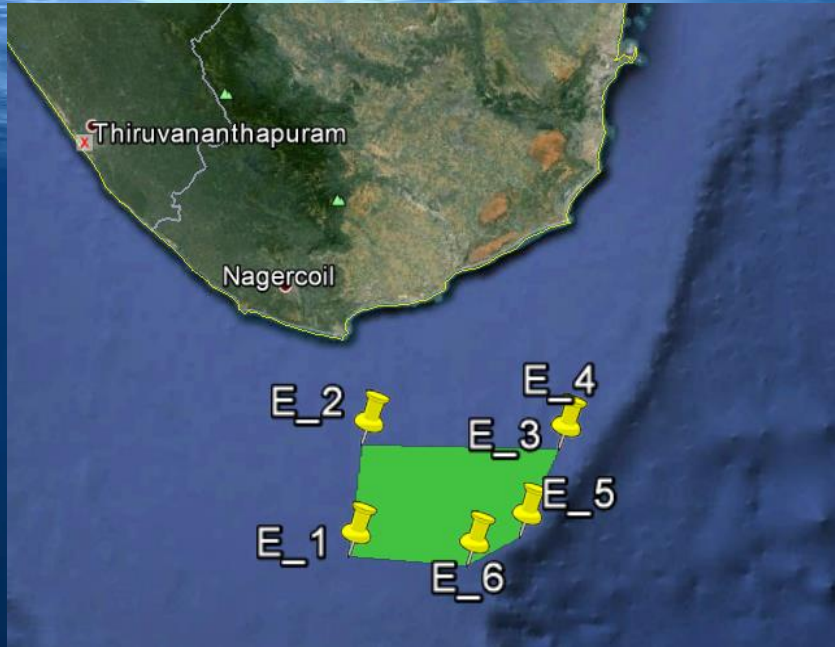
# Location of the offshore structure at TAMIL NADU



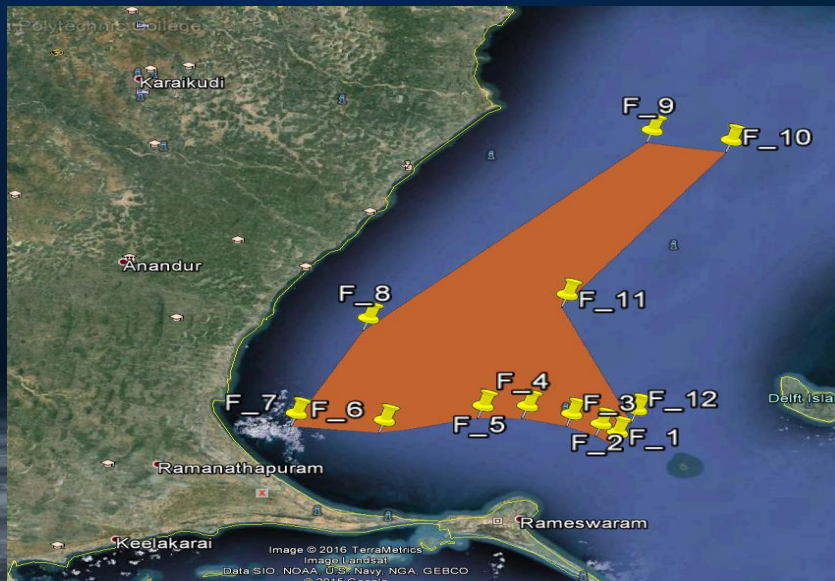
| Sl. No. | Zone C | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
| 1       | C_1    | 8.73207867     | 78.48050778      | 810                     |
| 2       | C_2    | 8.78947766     | 78.44521234      |                         |
| 3       | C_3    | 8.83351095     | 78.43065445      |                         |
| 4       | C_4    | 8.84533106     | 78.41936467      |                         |
| 5       | C_5    | 8.8531847      | 78.41783353      |                         |
| 6       | C_6    | 8.883918       | 78.46933664      |                         |
| 7       | C_7    | 8.95909274     | 78.67260825      |                         |
| 8       | C_8    | 8.98200937     | 78.71305583      |                         |
| 9       | C_9    | 8.98517305     | 78.80622804      |                         |
| 10      | C_10   | 9.00437245     | 78.89238694      |                         |
| 11      | C_11   | 9.01914052     | 78.9232853       |                         |
| 12      | C_12   | 9.04104339     | 79.06663922      |                         |
| 13      | C_13   | 9.07805401     | 79.20174678      |                         |
| 14      | C_14   | 9.05820887     | 79.28751114      |                         |
| 15      | C_15   | 8.96439127     | 79.50659106      |                         |
| 16      | C_16   | 8.91693499     | 79.49061898      |                         |
| 17      | C_17   | 9.01266913     | 79.25433183      |                         |
| 18      | C_18   | 9.02079774     | 79.19053917      |                         |
| 19      | C_19   | 8.99464402     | 78.96177966      |                         |
| 20      | C_20   | 8.8516538      | 78.59456448      |                         |

| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone D |                |                  | 1015                    |
| 1       | D_1    | 7.86139162     | 78.0816031       |                         |
| 2       | D_2    | 8.26231966     | 78.07387851      |                         |
| 3       | D_3    | 8.31622736     | 78.14779691      |                         |
| 4       | D_4    | 8.31267636     | 78.26473533      |                         |
| 5       | D_5    | 8.29492086     | 78.27186573      |                         |
| 6       | D_6    | 8.28781844     | 78.33889141      |                         |
| 7       | D_7    | 8.12797971     | 78.29610906      |                         |
| 8       | D_8    | 8.10666298     | 78.27828308      |                         |
| 9       | D_9    | 8.06260477     | 78.27043965      |                         |
| 10      | D_10   | 7.86513625     | 78.15207514      |                         |

# Location of the offshore structure at TAMIL NADU

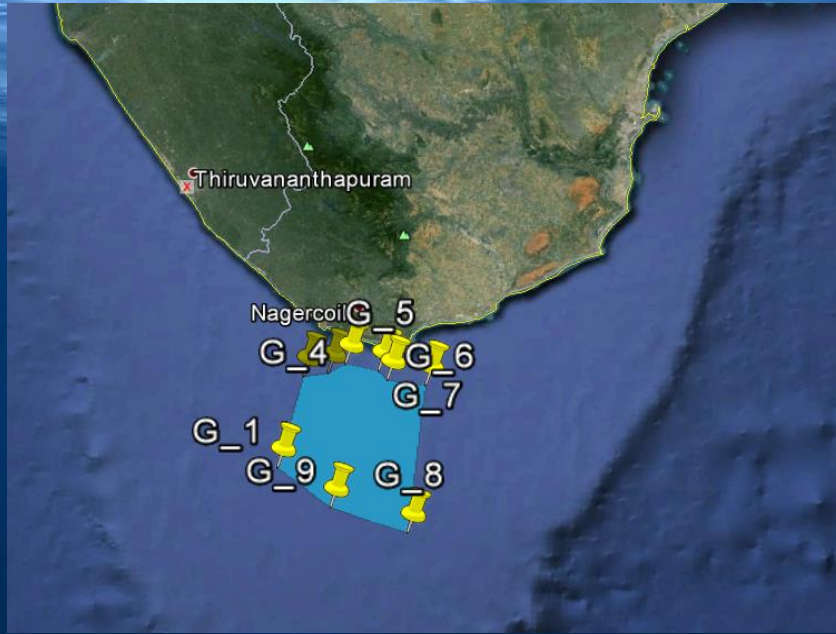


| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone E |                |                  | 1316                    |
| 1       | E_1    | 7.57955448     | 77.59532623      |                         |
| 2       | E_2    | 7.83299767     | 77.61106855      |                         |
| 3       | E_3    | 7.84971502     | 78.06949163      |                         |
| 4       | E_4    | 7.84864855     | 78.06949728      |                         |
| 5       | E_5    | 7.64478517     | 77.98962105      |                         |
| 6       | E_6    | 7.57362536     | 77.87103471      |                         |

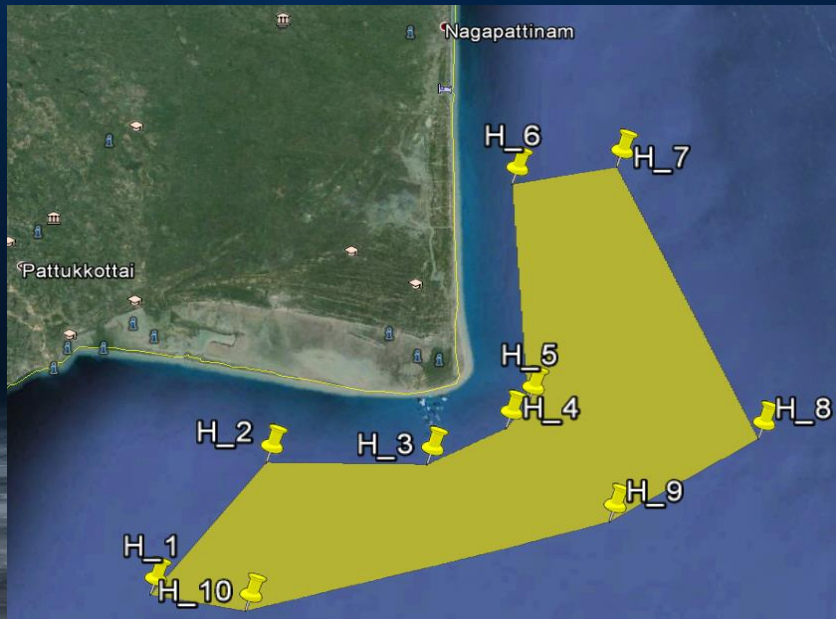


| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone F |                |                  | 1556                    |
| 1       | F_1    | 9.42557891     | 79.4311462       |                         |
| 2       | F_2    | 9.44021113     | 79.40904199      |                         |
| 3       | F_3    | 9.45625865     | 79.37006251      |                         |
| 4       | F_4    | 9.46900174     | 79.31130809      |                         |
| 5       | F_5    | 9.46734988     | 79.25245858      |                         |
| 6       | F_6    | 9.43690714     | 79.12317666      |                         |
| 7       | F_7    | 9.44540306     | 79.00671359      |                         |
| 8       | F_8    | 9.62108509     | 79.09614793      |                         |
| 9       | F_9    | 9.97753049     | 79.46502687      |                         |
| 10      | F_10   | 9.96245076     | 79.57150739      |                         |
| 11      | F_11   | 9.67202952     | 79.35854635      |                         |
| 12      | F_12   | 9.46631746     | 79.45551968      |                         |

# Location of the offshore structure at TAMIL NADU



| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone G |                |                  | 1602                    |
| 1       | G_1    | 7.73561858     | 77.21733623      |                         |
| 2       | G_2    | 7.98624941     | 77.27259677      |                         |
| 3       | G_3    | 7.99868805     | 77.33855289      |                         |
| 4       | G_4    | 8.0271178      | 77.38490044      |                         |
| 5       | G_5    | 8.01290318     | 77.47581294      |                         |
| 6       | G_6    | 7.98980334     | 77.50076931      |                         |
| 7       | G_7    | 7.98091844     | 77.60594259      |                         |
| 8       | G_8    | 7.57911968     | 77.57920362      |                         |
| 9       | G_9    | 7.6360351      | 77.36707446      |                         |

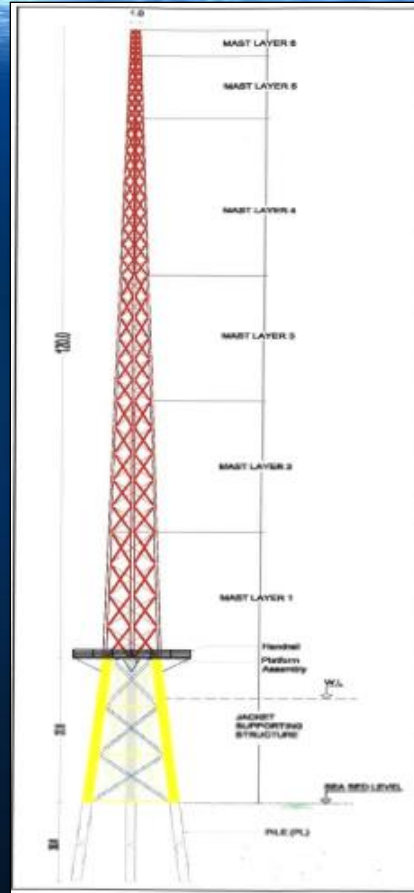


| Sl. No. |        | Latitude North | Longitude - East | Area (Km <sup>2</sup> ) |
|---------|--------|----------------|------------------|-------------------------|
|         | Zone H |                |                  | 2116                    |
| 1       | H-1    | 9.98880055     | 79.49307308      |                         |
| 2       | H-2    | 10.17157923    | 79.6347302       |                         |
| 3       | H-3    | 10.17534676    | 79.83913476      |                         |
| 4       | H-4    | 10.22714565    | 79.93800953      |                         |
| 5       | H-5    | 10.26104574    | 79.96462966      |                         |
| 6       | H-6    | 10.55563199    | 79.93515737      |                         |
| 7       | H-7    | 10.58291159    | 80.06825802      |                         |
| 8       | H-8    | 10.22243701    | 80.26030324      |                         |
| 9       | H-9    | 10.10564028    | 80.07396233      |                         |
| 10      | H-10   | 9.97089392     | 79.6147651       |                         |

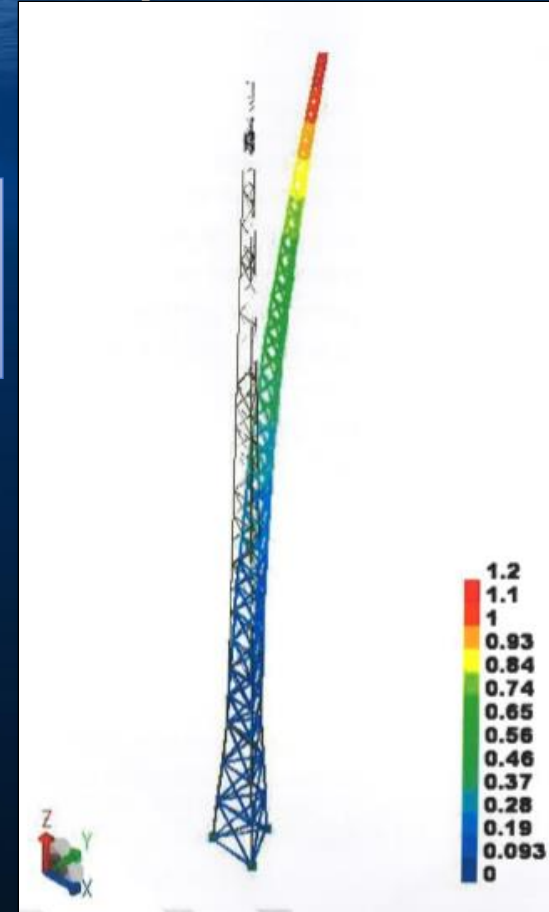
## FUTURE PLANS



2. Installation of 120 m offshore met mast both at Gujarat and Tamil Nadu coasts



Design of  
120m offshore  
met mast  
underway



3. Demarcation of wind potential zones both for Gujarat and Tamil Nadu coasts for ICB.



# National Institute of Wind Energy (NIWE)

## Chennai – 600 100



***Thank You***