

# Wind maps for SWT in Mexico



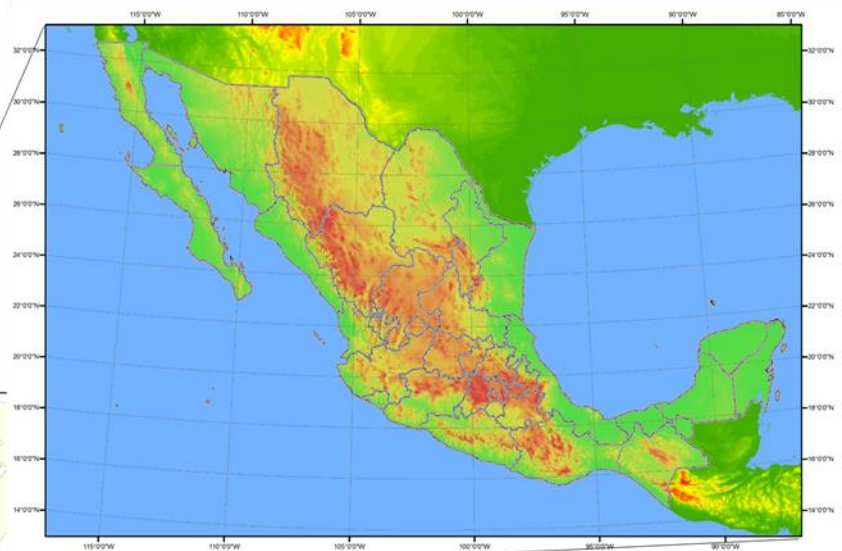
Ricardo Saldaña

[rsf@ineel.mx](mailto:rsf@ineel.mx)

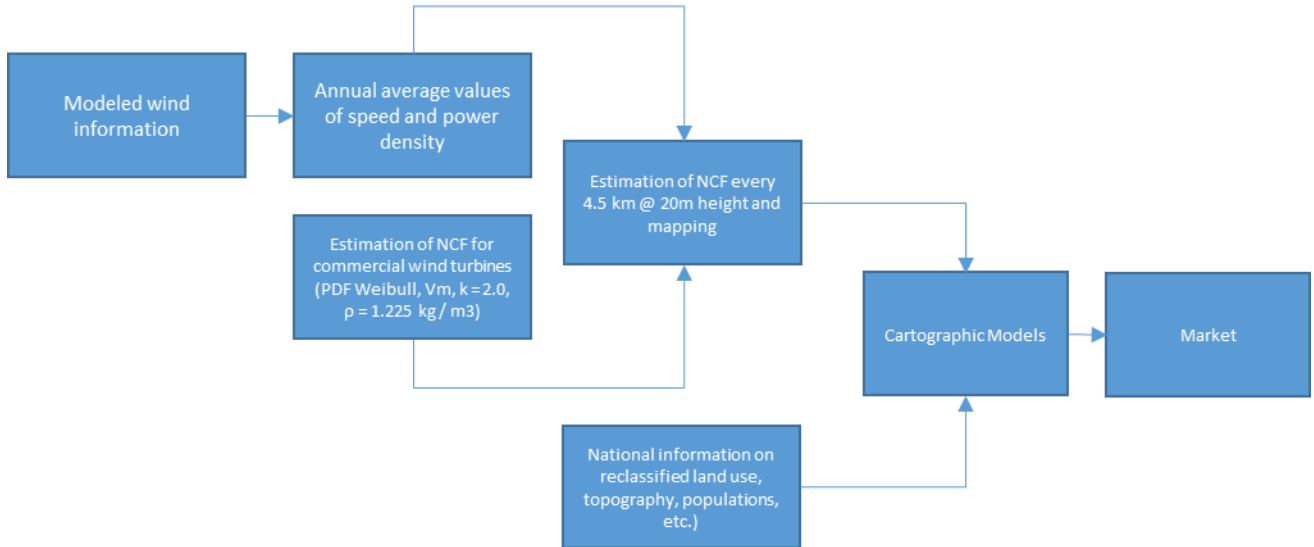
**Renewable Energy Department  
National Institute of Electricity and  
Clean Energies (INEEL)**

# Area of study

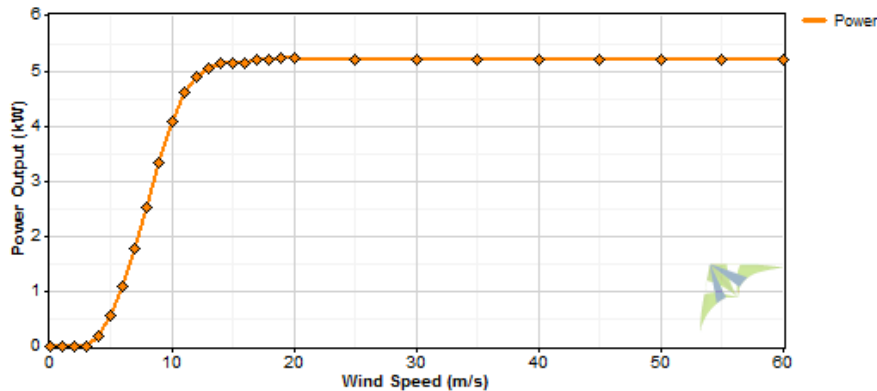
Latitude: 15°; 33°, longitude:-86;-118  
Area:  $2 \times 10^6$  km<sup>2</sup>  
Elevation: from 0 up to 5600 m agl



# Methodology



# 5 kW commercial turbine

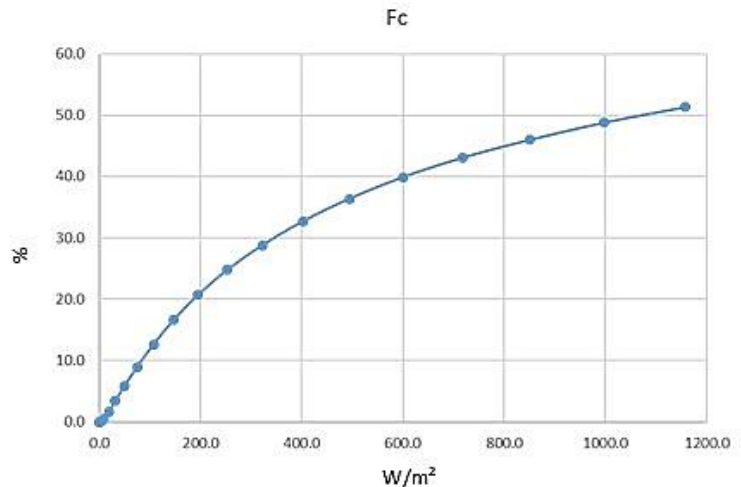


Wind Speed (m/s)	Power Output (kW)
0.0	0.000
1.0	0.000
2.0	0.000
3.0	0.014
4.0	0.210
5.0	0.576
6.0	1.104
7.0	1.783
8.0	2.542
9.0	3.349
10.0	4.077
11.0	4.628
12.0	4.911
13.0	5.066
14.0	5.141
15.0	5.142
16.0	5.159
17.0	5.217
18.0	5.212
19.0	5.242
20.0	5.235
25.0	5.200
30.0	5.200
35.0	5.200
40.0	5.200
45.0	5.200
50.0	5.200
55.0	5.200
60.0	5.200



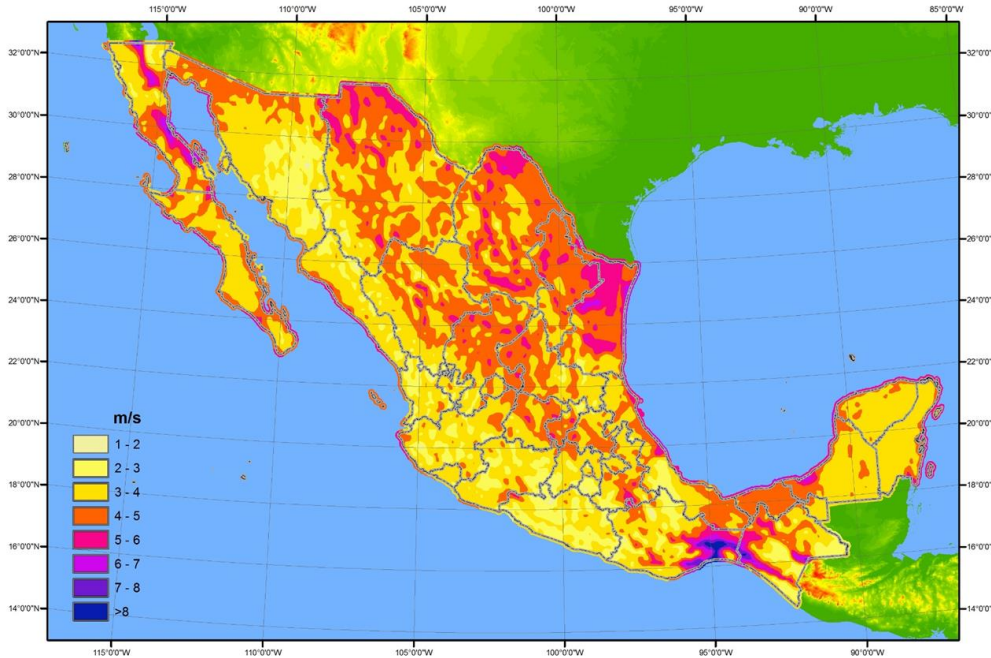
# Determination of Net Capacity Factors (5 kW commercial wind turbine)

Vprom	DP	Fc
0.000	0.000	0.0
0.500	0.283	0.0
1.000	1.128	0.0
1.500	4.178	0.1
2.000	9.660	0.5
2.500	18.661	1.6
3.000	32.044	3.4
3.500	50.691	5.9
4.000	75.497	9.0
4.500	107.286	12.6
5.000	146.989	16.6
5.500	195.466	20.7
6.000	253.593	24.8
6.500	322.248	28.8
7.000	402.303	32.7
7.500	494.608	36.4
8.000	599.938	39.9
8.500	718.879	43.1
9.000	851.673	46.0
9.500	998.040	48.8
10.000	1157.054	51.3



# Preliminary results

## Wind speed at 20 m height

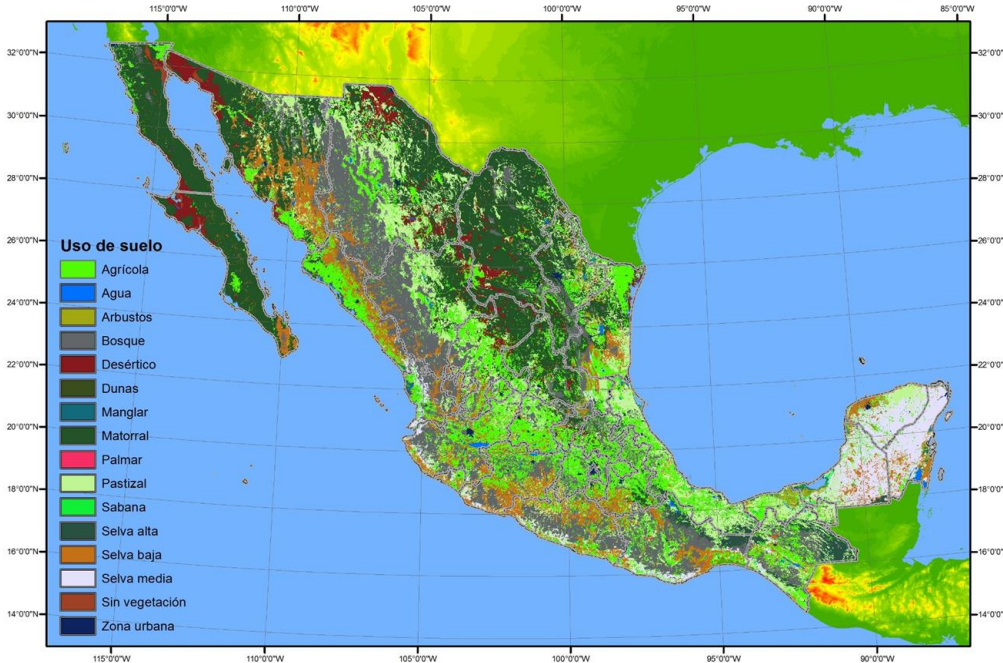


- Modeled with MM5 for 2005 at 50 m height with 4.5 km of resolution.
- Calculated at 20 m height by using an 1/5 exponent.



# Preliminary results

## Land use obtained from INEGI

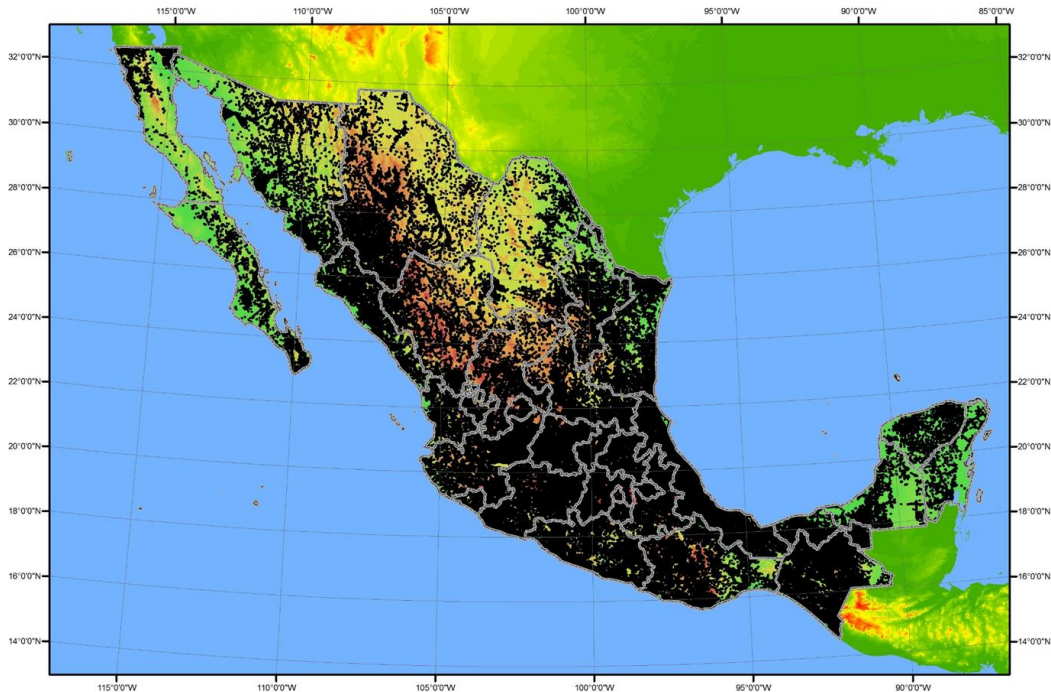


178 classes of Land Use and Vegetation reduced to 17 classes according to the possibility of wind turbines installation



# Preliminary results

## Total of populations



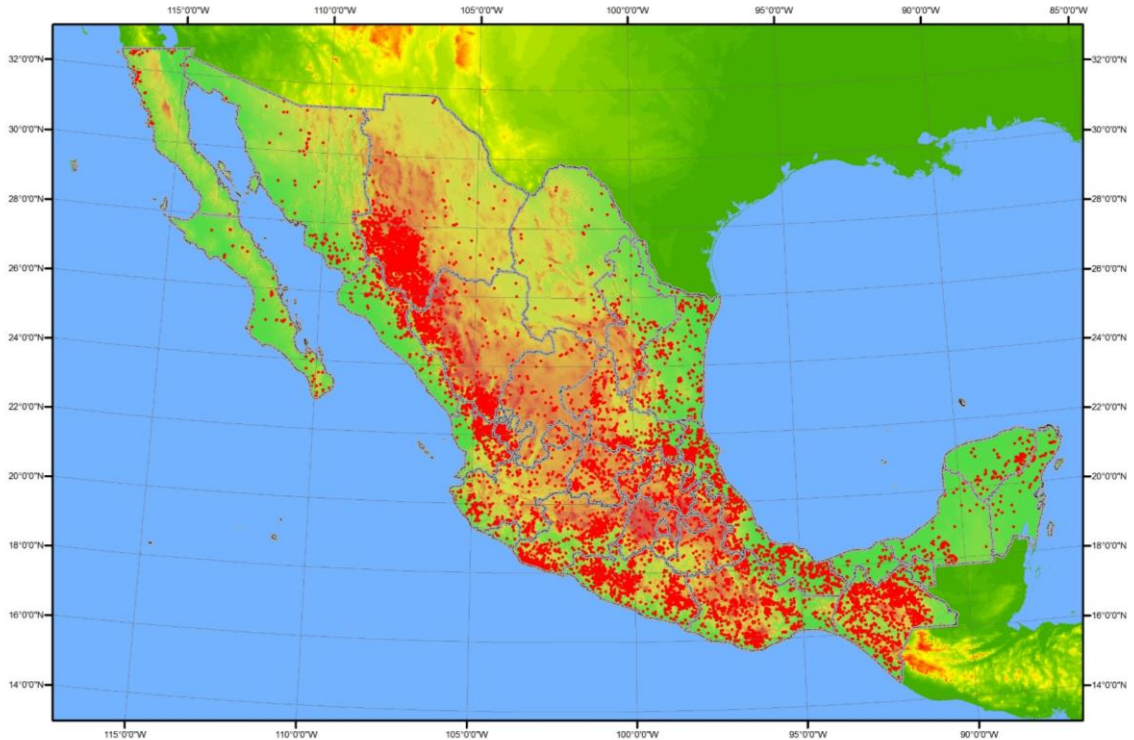
192,247  
populations,  
from a house to  
a big city





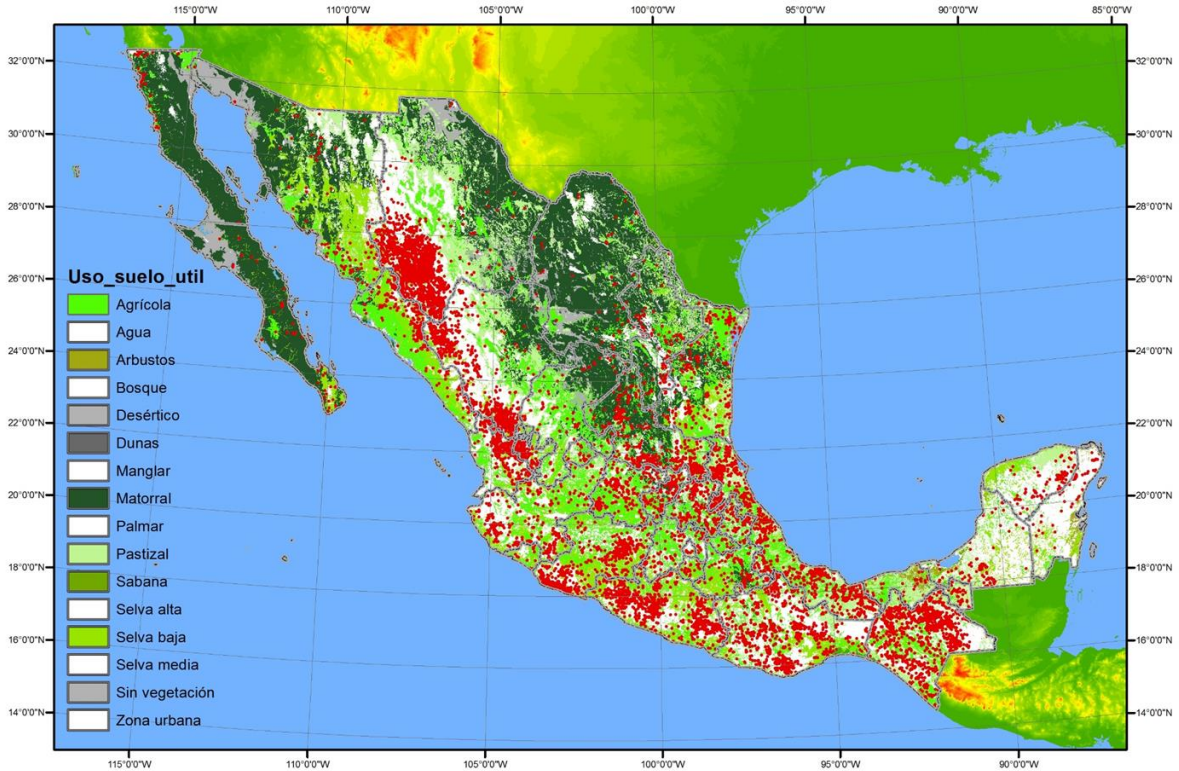
# Preliminary results

**Populations greater than 5 houses that have electrification less than 50%, according to the 2010 census**



# Resultados preliminares

## Candidate sites for SWT installation



## Recent activities

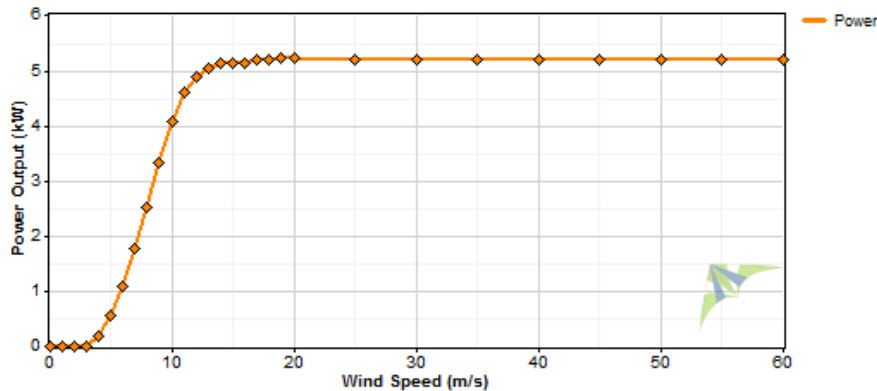
- Pre-definition of cartographic models for the identification of potential sites for the installation of SWT.
- Preparation of national maps of NCF for commercial SWT.
- Identification of potential sites for the installation of SWT.
- Integration of a querying GIS.

## Preparation of national maps of NCF for commercial SWT

SWT	Hub height (m)
Evance R-9000 5 kW	20.0
Bergey Excel-S 10 kW	43.0
Endurance G3120 35 kW	42.7
Norther Power 100-24 100 kW	37.0
EWT DW 54-500 500kW	75.0



# 5 kW commercial turbine

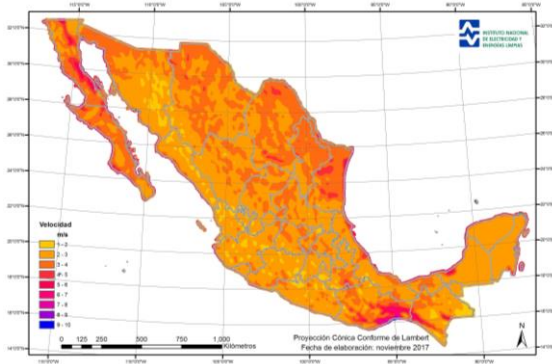


Wind Speed (m/s)	Power Output (kW)
0.0	0.000
1.0	0.000
2.0	0.000
3.0	0.014
4.0	0.210
5.0	0.576
6.0	1.104
7.0	1.783
8.0	2.542
9.0	3.349
10.0	4.077
11.0	4.628
12.0	4.911
13.0	5.066
14.0	5.141
15.0	5.142
16.0	5.159
17.0	5.217
18.0	5.212
19.0	5.242
20.0	5.235
25.0	5.200
30.0	5.200
35.0	5.200
40.0	5.200
45.0	5.200
50.0	5.200
55.0	5.200
60.0	5.200



# Parameters at 20 m height

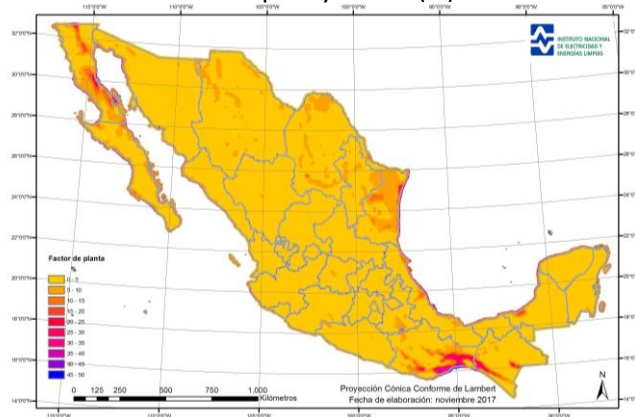
## Speed (m/s)



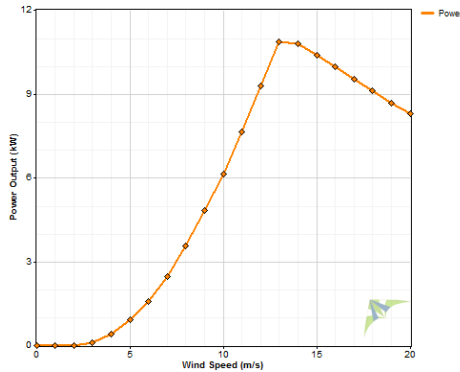
## Power density (W/m<sup>2</sup>)



## Capacity factor (%)



# 10 kW commercial turbine

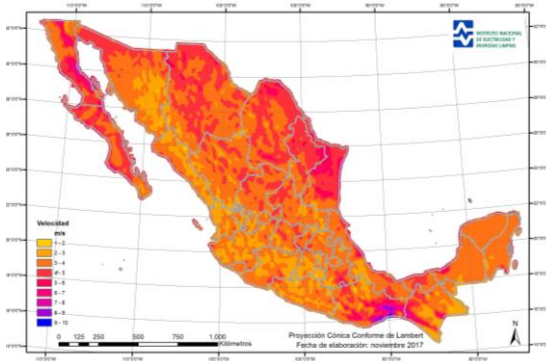


Wind Speed (m/s)	Power Output (kW)
0	0
1	0
2	0
3	0.12
4	0.42
5	0.94
6	1.6
7	2.5
8	3.6
9	4.85
10	6.15
11	7.65
12	9.3
13	10.9
14	10.8
15	10.4
16	10
17	9.55
18	9.15
19	8.7
20	8.3

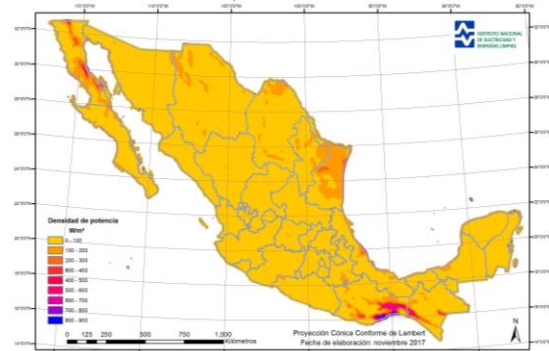


# Parameters at 43 m height

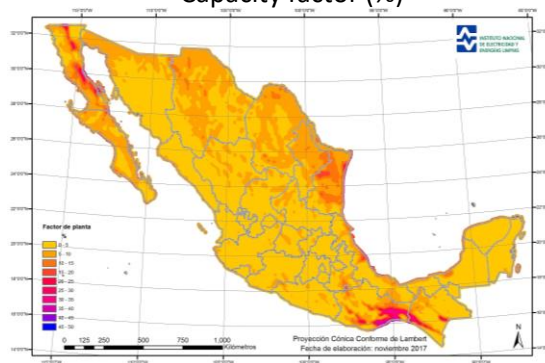
## Speed (m/s)



## Power density (W/m<sup>2</sup>)

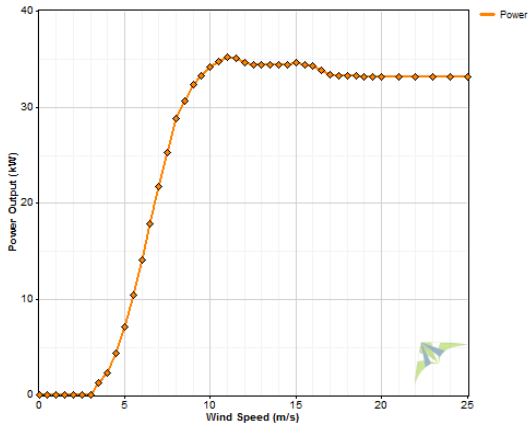


## Capacity factor (%)





# 35 kW commercial turbine

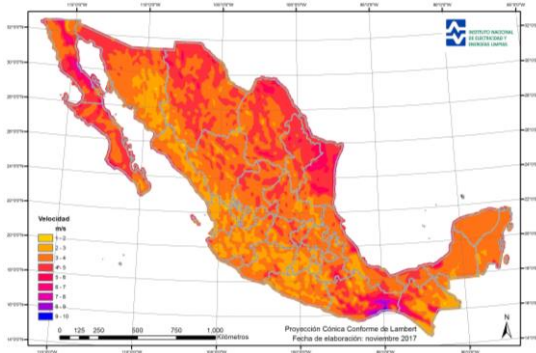


Wind Speed (m/s)	Power Output (kW)
0	0
0.5	0
1	0
1.5	0
2	0
2.5	0
3	0
3.5	1.31
4	2.358
4.5	4.422
5	7.176
5.5	10.45
6	14.1
6.5	17.83
7	21.751
7.5	25.371
8	28.84
8.5	30.723
9	32.347
9.5	33.274
10	34.174
10.5	34.809
11	35.235
11.5	35.089
12	34.663
12.5	34.444
13	34.41
13.5	34.41
14	34.41
14.5	34.41
15	34.693
15.5	34.483
16	34.333
16.5	33.837
17	33.409
17.5	33.358
18	33.321
18.5	33.284
19	33.247
19.5	33.21
20	33.173
21	33.173
22	33.173
23	33.173
24	33.173
25	33.173

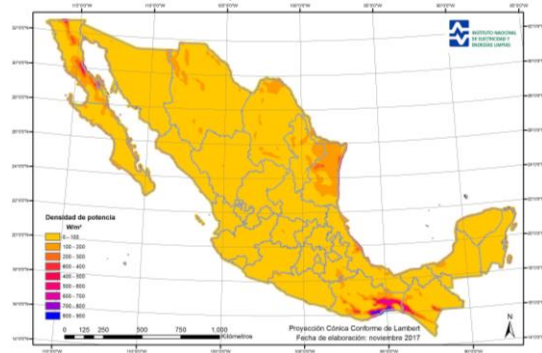


## Parameters at 42 m height

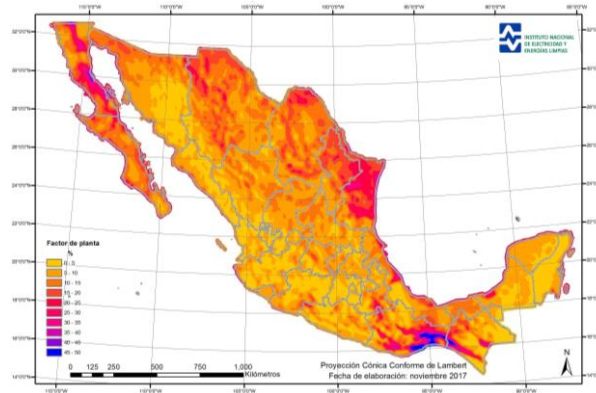
### Speed (m/s)



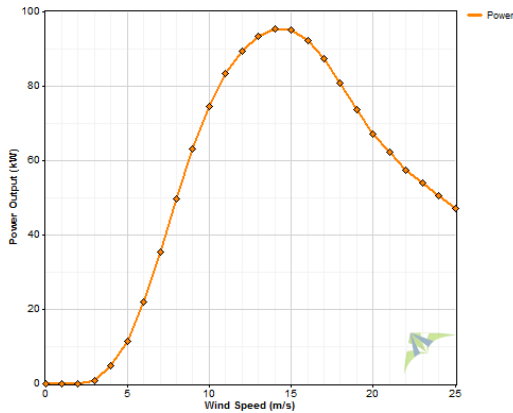
### Power density (W/m<sup>2</sup>)



### Capacity factor (%)



# 100 kW commercial turbine

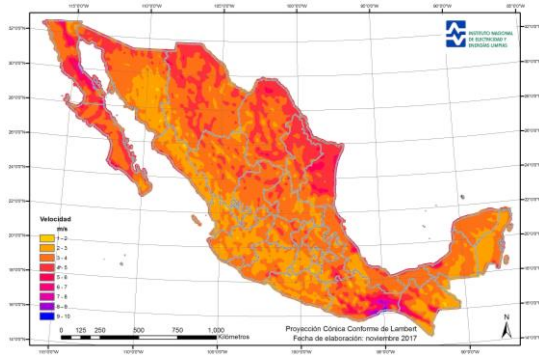


Wind Speed (m/s)	Power Output (kW)
0	0
1	0
2	0
3	0.9
4	5
5	11.7
6	22.2
7	35.5
8	49.9
9	63.4
10	74.7
11	83.5
12	89.7
13	93.7
14	95.5
15	95.2
16	92.5
17	87.7
18	81.1
19	73.8
20	67.3
21	62.4
22	57.7
23	54
24	50.6
25	47.4

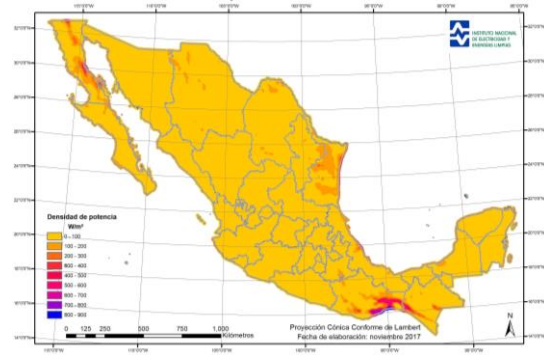


# Parameters at 37 m height

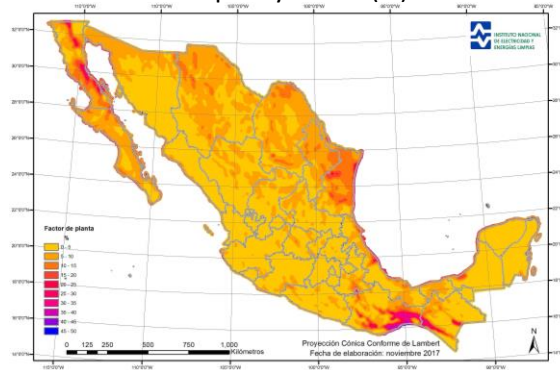
## Speed (m/s)



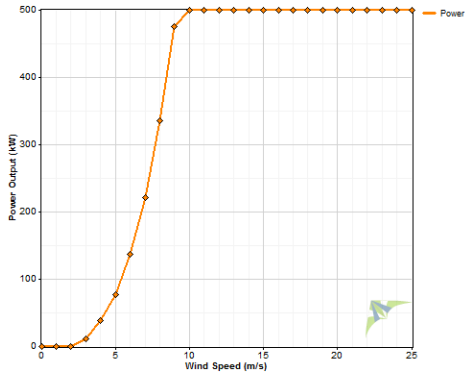
## Power density (W/m<sup>2</sup>)



## Capacity factor (%)



# 500 kW commercial turbine

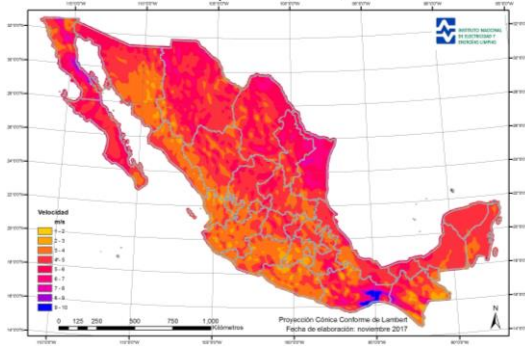


Wind Speed (m/s)	Power Output (kW)
0	0
1	0
2	0
3	12
4	39
5	78
6	138
7	222
8	337
9	477
10	500
11	500
12	500
13	500
14	500
15	500
16	500
17	500
18	500
19	500
20	500
21	500
22	500
23	500
24	500
25	500

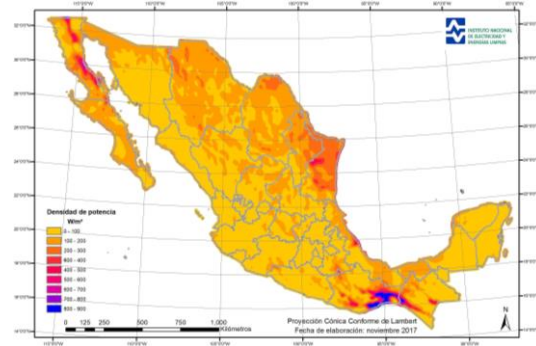


# Parameters at 75 m height

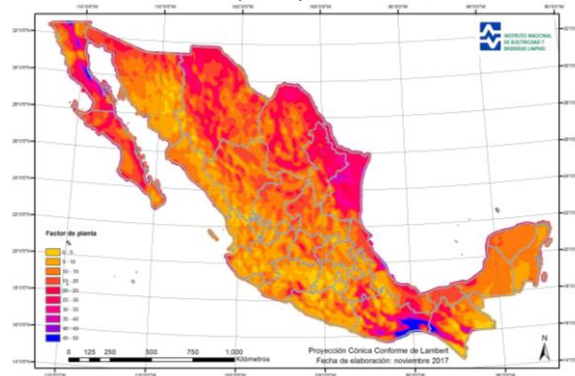
## Speed (m/s)



## Power density (W/m<sup>2</sup>)



## Capacity factor (%)



**Thanks for  
your  
attention!**

