Wind Generation
Kazakhstan has set up ambitious goals to move to a more sustainable energy matrix.

“The era of a hydrocarbon economy is coming to its end” Nazarbayev, 2012

- 15-25% reduction in greenhouse gas emissions below 1990 levels by 2030
- Solar and wind to provide 3% of total power generation in 2020; 30% in 2030 and 50% in 2050
- 25% reduction in energy intensity of GDP below 2008 levels by 2020

Installed generation capacity (MW) -2017

<table>
<thead>
<tr>
<th>Year</th>
<th>Oil</th>
<th>Hydro</th>
<th>Gas</th>
<th>Coal</th>
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<tr>
<td>2018</td>
<td>708</td>
<td>2.512</td>
<td>4.362</td>
<td>12.216</td>
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Renewable generation - Announced
- Samruk – Kazina Kyzylorda (50MW) – Solar
- Samruk-Energo Kapchagay (2MW) – Solar
- Shokpa Windwarm (400MW) – Wind
- ENE – (50MW) – Wind
The following training is designed to get an overall understanding of Wind Generation from hands-on-work perspective, providing an overview of the main aspects of the Lifecycle of a wind generation project.

### Course structure

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<th>Module 2: Project feasibility</th>
<th>Module 3: EPC</th>
<th>Module 4: Transmission &amp; Distribution models</th>
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<td>Allocation &amp; Resources</td>
<td>Design &amp; Engineering</td>
<td>Grids -Mini Grids Clustered DER</td>
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<td>Dimensioning &amp; designing</td>
<td>Contracting Procurement Logistics</td>
<td>Mini utility, metering &amp; Collection</td>
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<td>Financial modelling</td>
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<td>Utility scale</td>
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<td>Inverters</td>
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<td>H&amp;S</td>
<td>Forms of contracts</td>
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Grid Overview.

1. Solar PV Field
2. Inverter
3. Storage Bank
4. Genset
5. Wind Turbine
6. Consumer/s & Metering
7. Transformer (Up/Down)
8. Grid (Transmission/Distribution)
9. Protections (DC)
10. Protections (AC)
11. Protections (HV) & Metering
12. Telecommunications
13. Remote Management (SCADA)
Module 1.1
Wind technology and market
Wind Generation Side.

Micro Turbines

0 to 30 kW

Small single facility
Auxiliary source
Do It Yourself

30 kW to 800 kW

ALMOST EMPTY

Very few products in the market

Utility Scale

800 kW to 12 MW

Manufacturers
Vertical integration with banks.
A Wind turbine is an electromechanical generation unit, where an inductive (spinning) generator or alternator is rotated by the effect of the wind against the blades of the rotor. Depending on the technology of the spinning generator. Today, the small units with less than 300 kW are no longer considered financially viable and the usual platform starts with 2 WM. The domestic types (< 300 kW) generate DC or AC and must be associated with a battery bank due to the extreme variability of their output and their lack of controls.
GE Renewable Energy is developing Haliade-X 12 MW, the biggest offshore wind turbine in the world, with 220-meter rotor, 107-meter blade, leading capacity factor (63%), and digital capabilities, that will help our customers find success in an increasingly competitive environment.

One Haliade-X 12 MW can generate 67 GWh annually, which is 45% more annual energy production (AEP) than most powerful machines on the market today, and twice as much as the Haliade 150-6MW.

The Haliade-X 12 MW turbine will generate enough clean power for up to 16,000 European households per turbine, and up to 1 million European households in a 750 MW configuration windfarm.

**HALLIADE-X 12 MW**

- **12 MW capacity**
- **220-meter rotor**
- **107-meter long blades**
- **260 meters high**
- **67 GWh gross AEP**
- **63% capacity factor**
- **38,000 m² swept area**

Wind Class IEC: IB

**Comparative Heights**

- **Flat Iron Building**: 285 ft (87 m)
- **Statue of Liberty**: 305 ft (93 m)
- **Washington Monument**: 555 ft (169 m)
- **Chrysler Building**: 1046 ft (319 m)
- **Empire State Building**: 1454 ft (443 m)
- **Haliade-X 12 MW**: 853 ft (260 m)
- **Eiffel Tower**: 1063 ft (324 m)
- **London Eye**: 443 ft (135 m)
- **Big Ben**: 315 ft (96 m)
- **Tower of Pisa**: 186 ft (57 m)
- **Arc de Triomphe**: 162 ft (49.5 m)