cooperación alemana
DEUTSCHE ZUSAMMENARBEIT

Implementada por:

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

# Forecasting of Variable Renewable Energies

## Program for Renewable Energies (PEERR II)

### Context

Bolivian enormous potential of existing solar and wind resources coupled with the reduced price of technologies whereby we can profit from such energies have significantly increased the participation of variable renewable energies (VRE) in the electricity matrix. However, the integration of these sources of electricity generation poses challenges to the electrical grid operation due to their fluctuating nature caused by their dependence on meteorological variables.

Therefore, the system technology must increase its flexibility with technological, regulatory, and operational measures, among which improving wind and solar photovoltaic generation forecasts stand out. With this, the planning and operation processes of the electricity system can be efficiently improved.

The VRE forecast is a strategy to manage these fluctuations with superior quality as it reduces the occurrence of events affecting the system. The forecast allows for better planning of the other elements involved in the system.

Forecasts accuracy has improved with the new technological advances since their aim is always to minimize forecast error. In general, there are several forecasting methodologies --some are based on historical data, others seek to model the physical world, while the most advanced forecasts combine both techniques.

### Center for Forecasting Variable Renewable Energies

The German Development Cooperation (GIZ), through its Program for Renewable Energy (PEERR II) in coordination with the Ministry of Hydrocarbons and Energy (VMEEA), the National Electricity Company (ENDE), and the National Electricity Load Dispatch Committee (CNDC) are working on this issue of national importance.

Within the framework of an inter-institutional agreement signed between Universidad Mayor de San Andrés (UMSA) and GIZ, technical assistance is provided to the work of the Center for Forecasting Variable Renewable Energies (CPERv).

CPERv implements and guarantees a stable VRE forecasting service (wind and solar photovoltaic) to power generation companies dependent on ENDE and the CNDC. The generated VRE forecast tends to follow a virtuous circle where all observations are fed permanently to the simulation model through the meteorological variables generated by national-level projects. Thus, better results and information are produced in sufficient time and used in energy dispatch decision-making, project planning, and operation.

CPERv
Centro de Pronóstico de Energías Renovables Variables

Furthermore, CPERv fosters the development and strengthening of local know-how and the training of professionals in REV forecasting, big data, and numerical simulations.

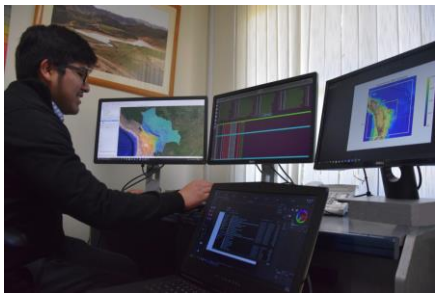
### Forecasting solar and wind energies

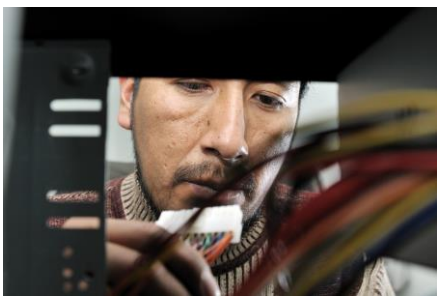
The forecasting system comprises two sections:

- Forecast of meteorological variables.
- Forecast of energy variables.

#### Forecasting meteorological variables

Daily the CPERv collects global meteorological data from the Global Forecast System (GFS). This data serves to generate a high-resolution forecast of the location of interest. During the forecast operation, the WRF System evaluates the location's physical parameters before starting the data post-processing. The weather forecast adjustment and validation take place using the weather station closest to the wind or solar photovoltaic plant as a reference.





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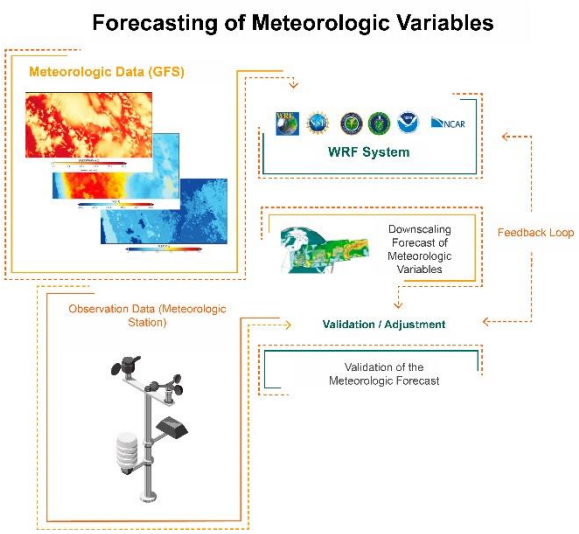
This procedure takes place daily to generate a focused meteorological forecast of the locations of interest.

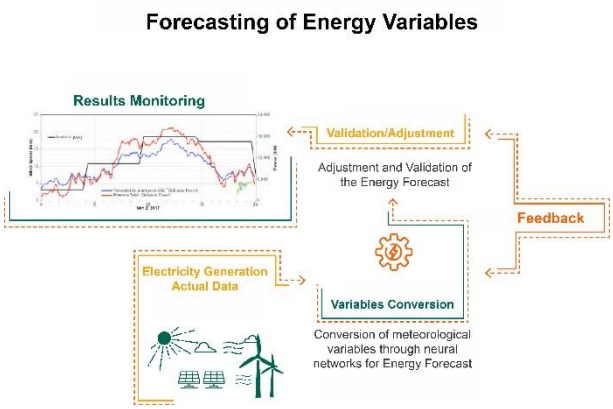
## Forecasting energy variables




CPERv develops energy forecasting from wind and solar photovoltaic resources using as input meteorological variables generated by the WRF system. The methodology for wind energy forecasting incorporates neural networks, which convert those atmospheric variables into energy while providing energy historical data feedback about energy injected into the network of each wind turbine. In addition, considering the atmospheric variables' technical characteristics for modeling closer to reality.

Moreover, the methodology for solar photovoltaic energy forecasting introduces the variables of solar irradiation, temperature, humidity, and other meteorological parameters that later are transformed into energy variables taking into consideration the technical characteristics of the photovoltaic plant.

Finally, once the forecast generation process is completed, error metric daily reports are generated from the previous day's forecast. Such statements are sent daily to the grid operator to evaluate and compare those results obtained and to improve the service provided by the CPERv. In conclusion, this forecasting tool greatly supports the electricity sector in terms of load pre-dispatch and medium-term planning because of the forecast characteristics and granularity delivered daily.




To access the CPERv website, scan the QR.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