Applying Weather Forecast for Improving Renewable Energy Integration into Microgrids

PO.027

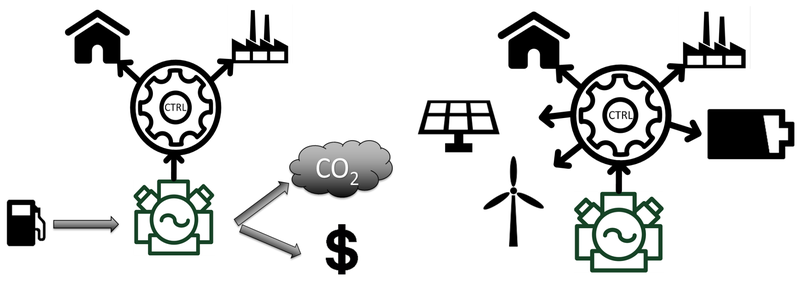
Antoine Amossé, Mauricio Higuita Cano, Karim Belmokhtar, Fernando Gomez
Nergica, Gaspe, Canada

Objectives

- Integrate renewable energy sources (RES) into microgrids in order to reduce the carbon footprint and decrease the cost of energy.
- Improve the reliability and stability of microgrids by adding energy storage systems to reduce the intermittency of RES.
- Implement a new energy management system to optimize the use of energy storage systems.
- Incorporate weather and energy forecasts to optimize the power distribution between energy storage systems and diesel power plants.

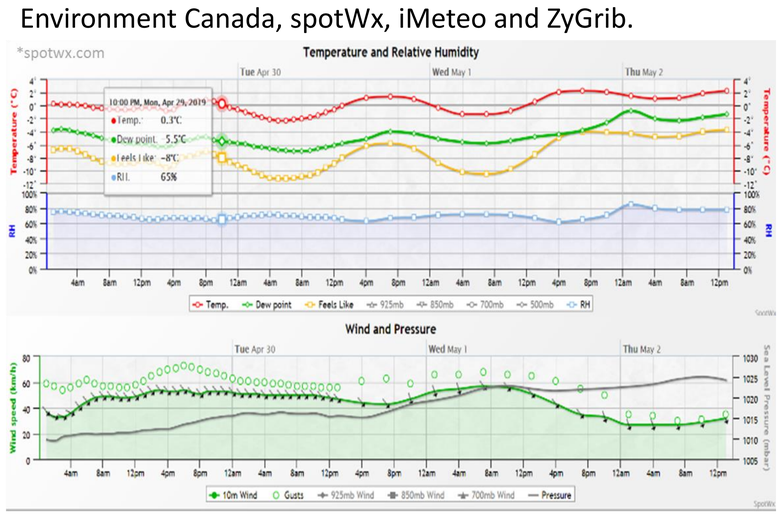
Context

- Isolated and northern communities are highly dependent on fossil fuels for electricity production.
- Off-grid sites in Canada consume more than 900 million liters of diesel annually.
- Significant public investment has been done to reduce the dependency of isolated communities in Canada.
- The public sector is currently investing significant resources in order to reduce the dependency of isolated communities on fossil fuels.



Weather Forecasting

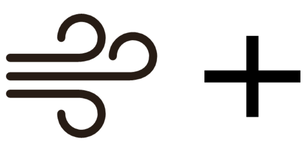
Wind, temperature and precipitation forecast models are available online from different sources such as Environment Canada, spotWx, iMeteo and ZyGrib.

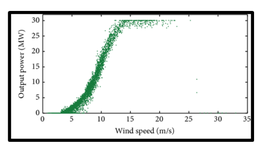


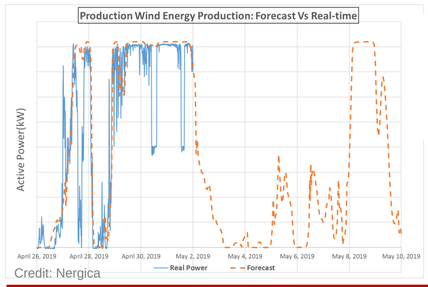
Temperature, Wind, Pressure and RH Forecasts

Energy Forecasting

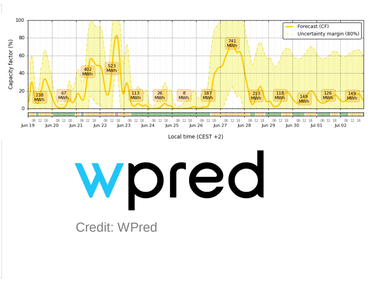
- Energy forecasts depend directly on weather forecasts and the accuracy of energy models.
- Wind and solar radiation forecasts allow a better prediction and management of the energy production in microgrids.
- Forecasting models use a combination of artificial intelligence (AI), machine learning tools and professional forecasting services.







Credit: Nergica

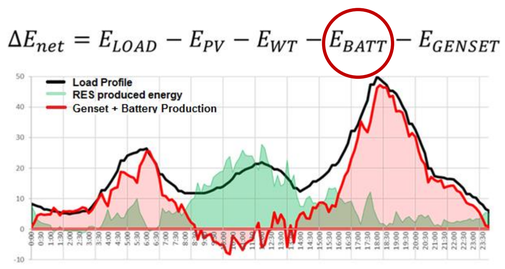


wpred

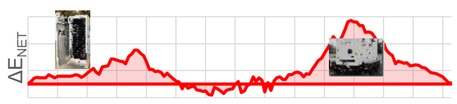
Credit: WPred

Applications : Energy Management and Ice Detection

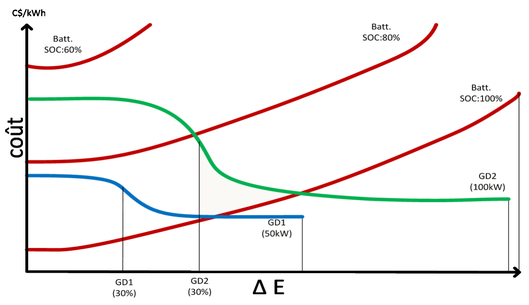
$$\Delta E_{net} = E_{LOAD} - E_{PV} - E_{WT} - E_{BATT} - E_{GENSET}$$



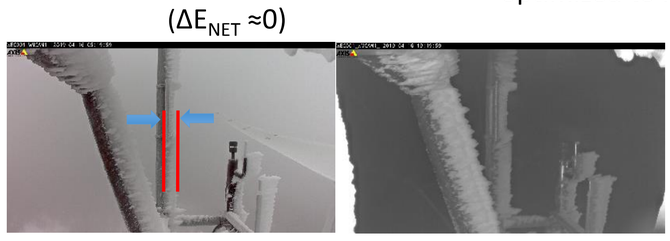
Energy forecasting data are used to develop energy production models that can predict shortages and excess energy.
The balance between production and load must be kept at all times.
($\Delta E_{NET} \approx 0$)

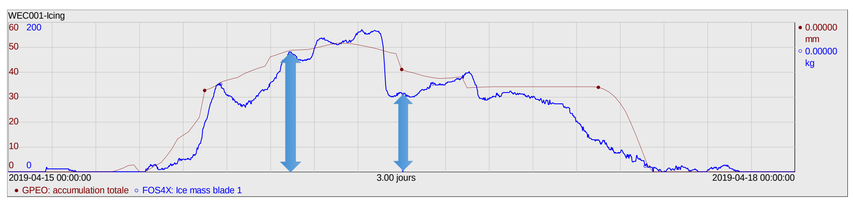


An advanced optimization tool is used to maximize the microgrid reliability and reduce the energy costs.
The power flux distribution in a microgrid is based on energy forecasting data and takes into account the operational constraints.
The dispatching of energy between batteries and diesel power plants is optimized to reduce energy costs.



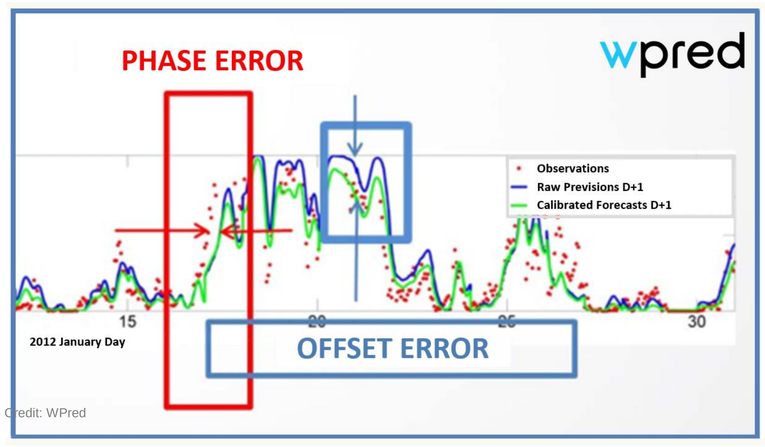
Cost assessment of an energy source.





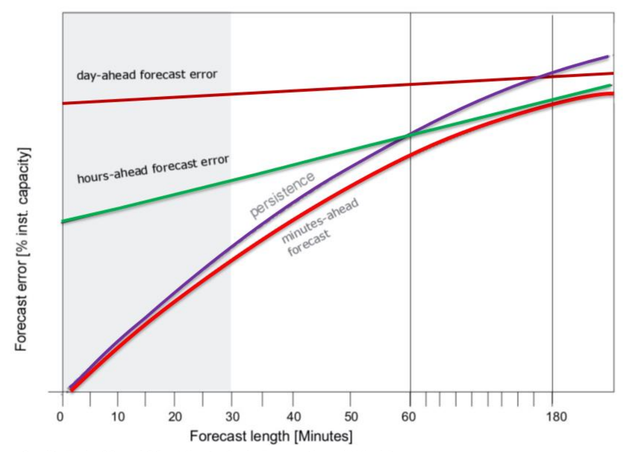
Weather forecasting data are used to detect icing events occurring on wind turbines or solar panels.
Objective : activation of a blade-heating or de-icing systems at the suitable time to minimize energy loss.

Data Processing and Analysis



Credit: WPred

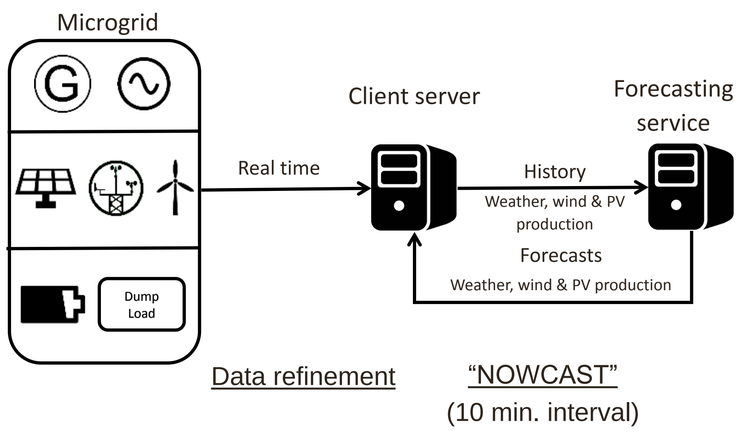
Type of forecasting model errors:
Offset, phase and random error



Credit: Tasks 32 and 36 – Minute-Scale Forecasting of Wind Power

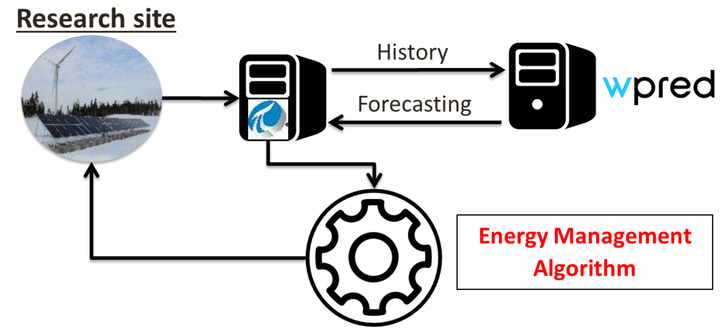
Uncertainty analysis:
Forecast error as a function of the frequency of forecasts.

Optimization of the Energy Management System



Forecasting Professional Services

- Historical data are fed to AI models in order to train them and obtain more reliable, refined and accurate forecasting data.
- A "NOWCAST" approach has been developed for better energy management in microgrids.



Increasing RES Integration using Weather and Energy Forecasting Data

We have conducted a two-stage project:

Stage 1 : Development and improvement of forecasting models.

At this stage the models are fed with real data from Nergica's microgrid.

Stage 2 : Development of an advanced control strategy.

In order to increase both the reliability and profitability of a microgrid, we have developed a control strategy based on weather and energy forecasting.

Conclusions

- Renewable energies are a great asset to reduce diesel dependency in off-grid communities.
- Weather and energy forecasts are used to reduce the impact of renewable energy intermittency and to increase the penetration rates of RES.
- An advanced algorithm is developed to increase both the reliability and profitability of microgrids.

For More Information

Access the complete webinar at:
https://nergica.com/en/webinars-microgrids-forecasts/

References

[1] P. Rivard, "Le jumelage Éolien- Micro Gnl : Une solution énergétique pour desservir les sites éloignés et les réseaux autonomes," 2013.
[2] I. Würth et al., "Minute-Scale Forecasting of Wind Power—Results from the Collaborative Workshop of IEAWind Task 32 and 36," Energies, vol. 12, no. 712, p. 30, 2019.
[3] Wpred, "SOLUTION DE NOWCASTING POUR PARCS ÉOLIENS." p. 14, 2017.

Contact: aamosse@nergica.com, www.nergica.com

Acknowledgments: The authors would like to thank the Natural Sciences and Engineering Research Council (NSERC) for its invaluable support in making this work possible.