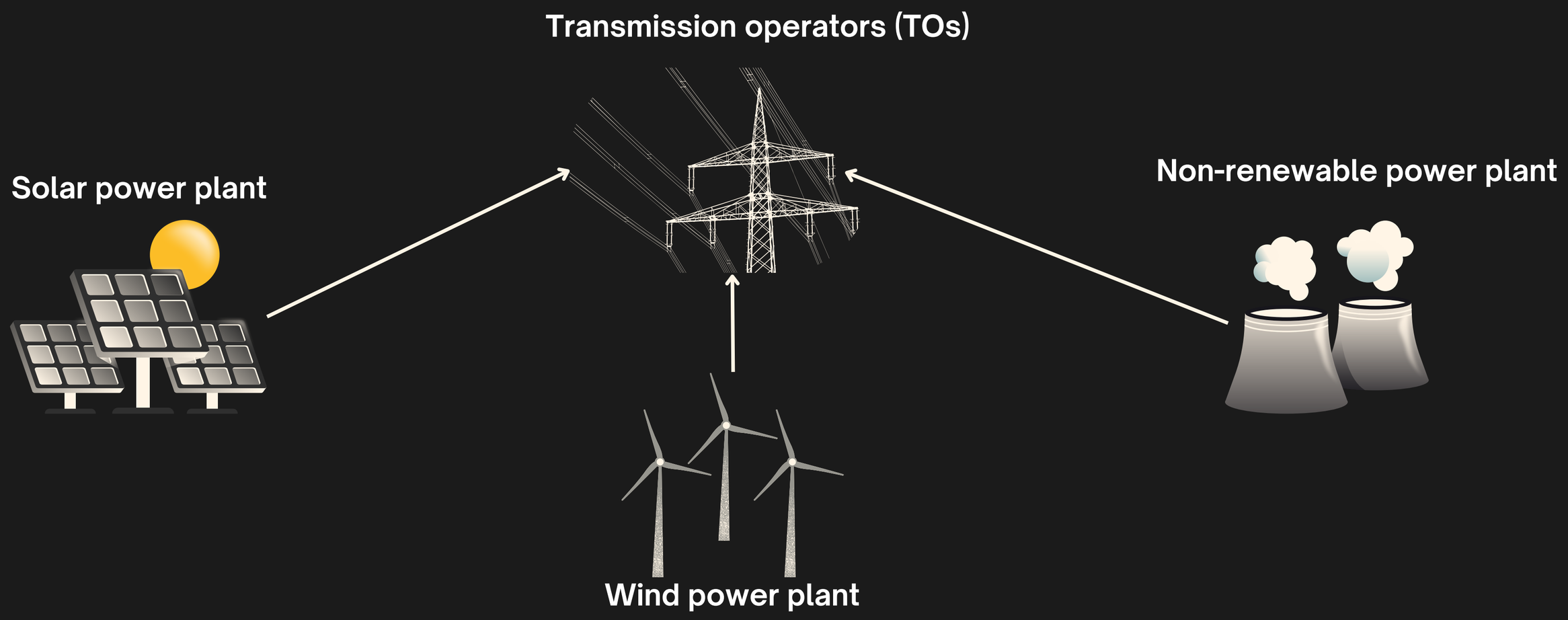
Predicting Wind Energy Curtailment in Germany

CAPSTONE PROJECT

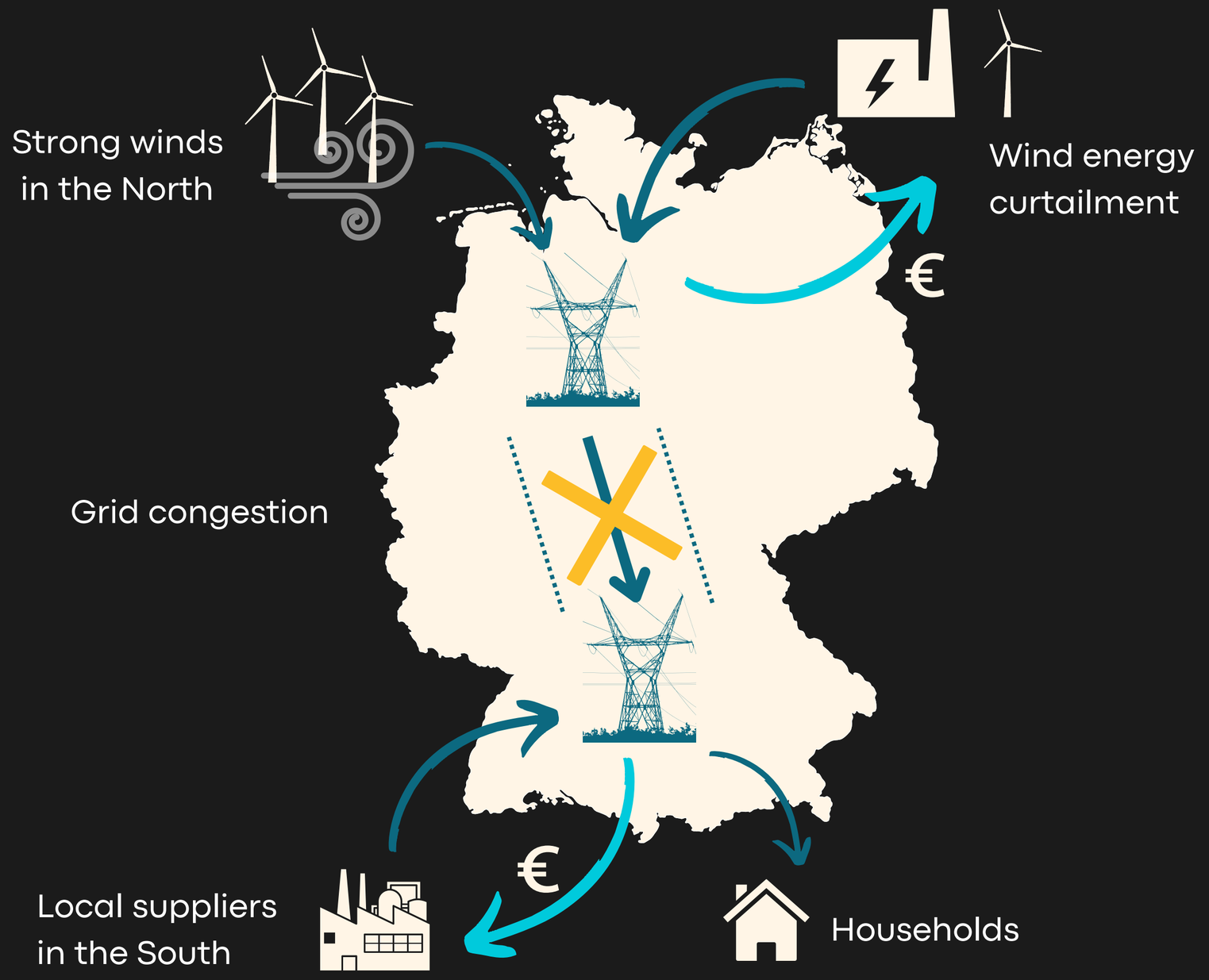
MARIE GONDECK
SHASHANK KUMAR

NEXTRACT ENERGY

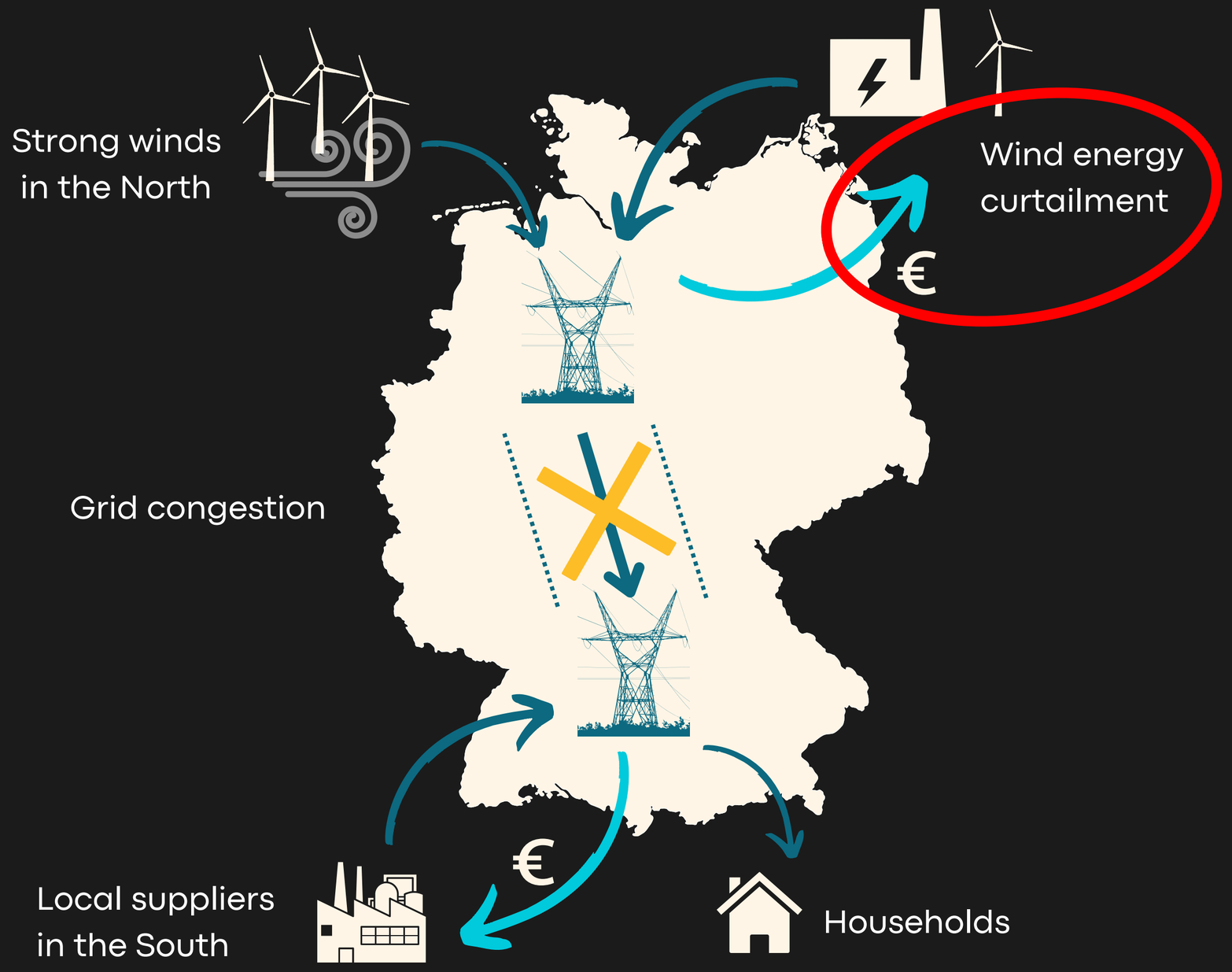
Dispatch & Transmission Operators



Redispatch


Strong winds
in the North
Wind energy
curtailment
€
Grid congestion
€
Local suppliers
in the South
Households

Redispatch


Strong winds
in the North
Wind energy
curtailment
€
Grid congestion
€
Local suppliers
in the South
Households

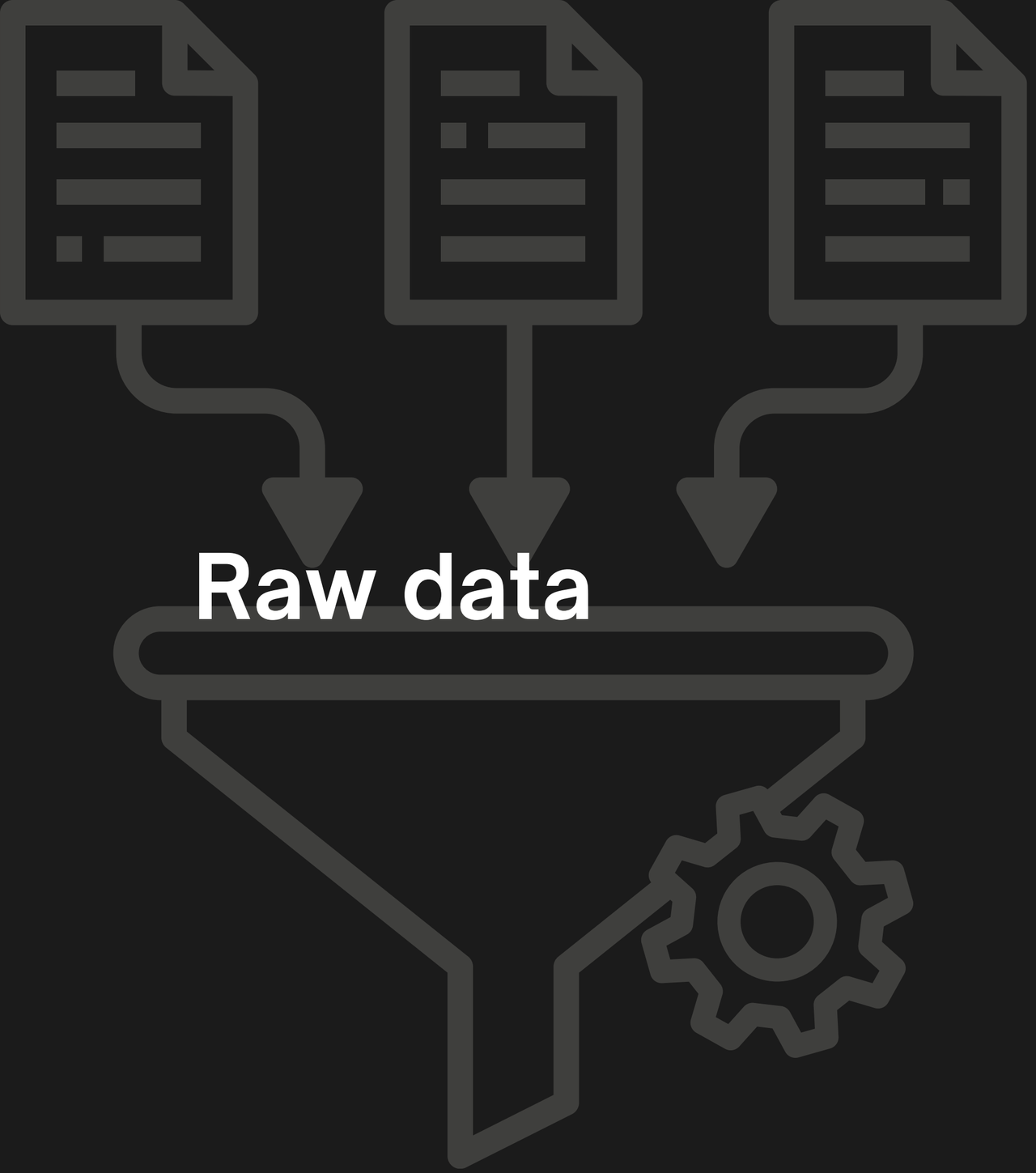
Business case for curtailment prediction

4% RENEWABLE ENERGY CURTAILED IN 2022

TO COMPENSATION

RENEWABLE ENERGY PRODUCERS

MISSED TARGETS



CURTAILMENT DATA

WEATHER DATA

ENERGY CONSUMPTION DATA

SOLAR ENERGY DATA

EVALUATION METRIC - PRECISION

Precision

$$\frac{\text{PREDICT curtailment ACTUAL curtailment}}{\text{PREDICT curtailment ACTUAL curtailment} + \text{PREDICT curtailment NO curtailment}}$$

Web app - Streamlit

Baseline model

Input - ‘Wind gust max’

Model - Predict based on value of wind gust

Threshold - 9m/s

Precision ~ 16%

Advanced model

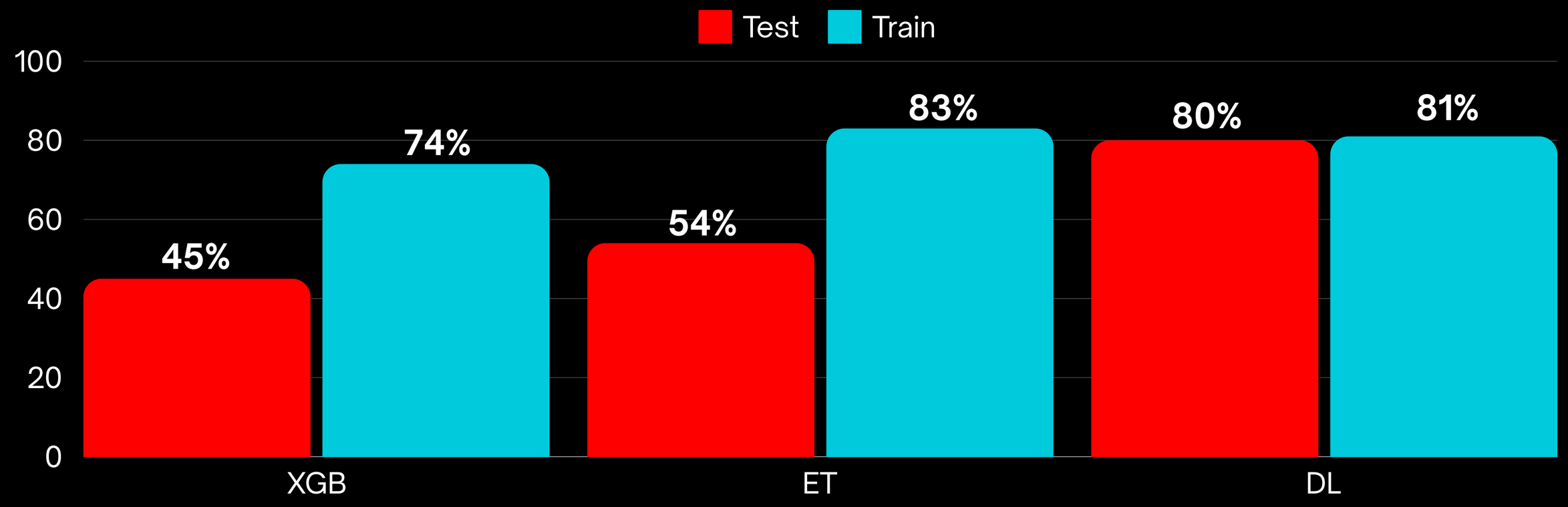
Joint database of all sources

Timeseries elements

Methods - XGBoost Classifier, Extra Trees Classifier, Deep Learning model

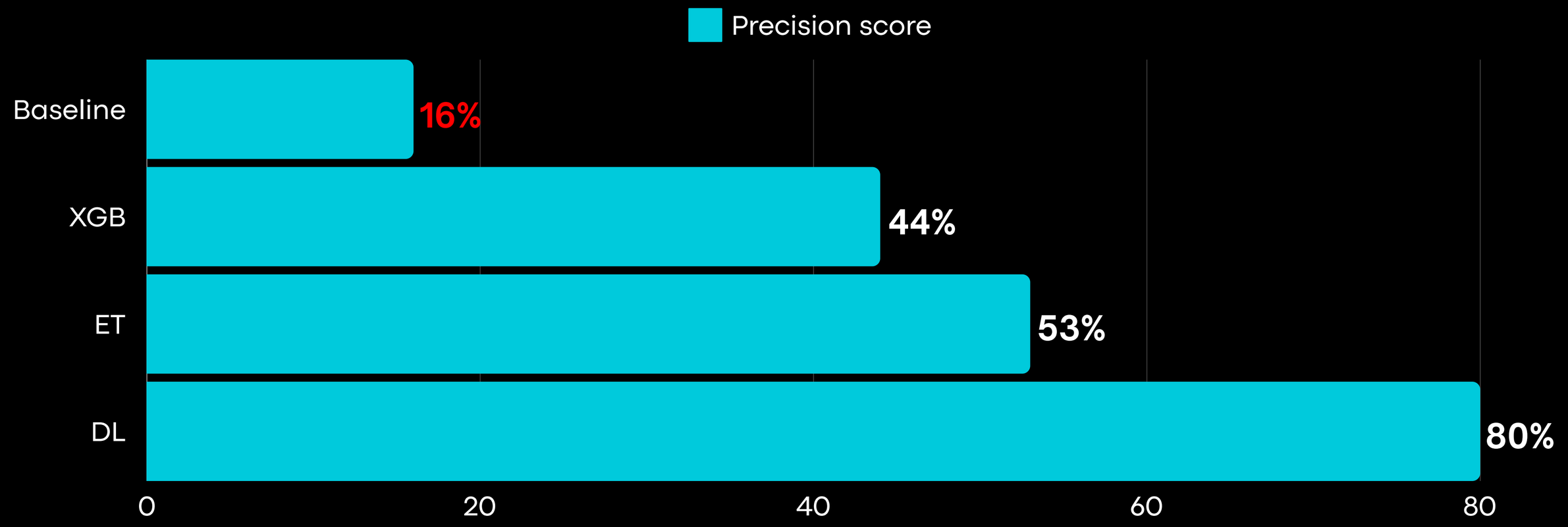
Model results

Performance of XGBoost vs Extra Trees vs Deep Learning

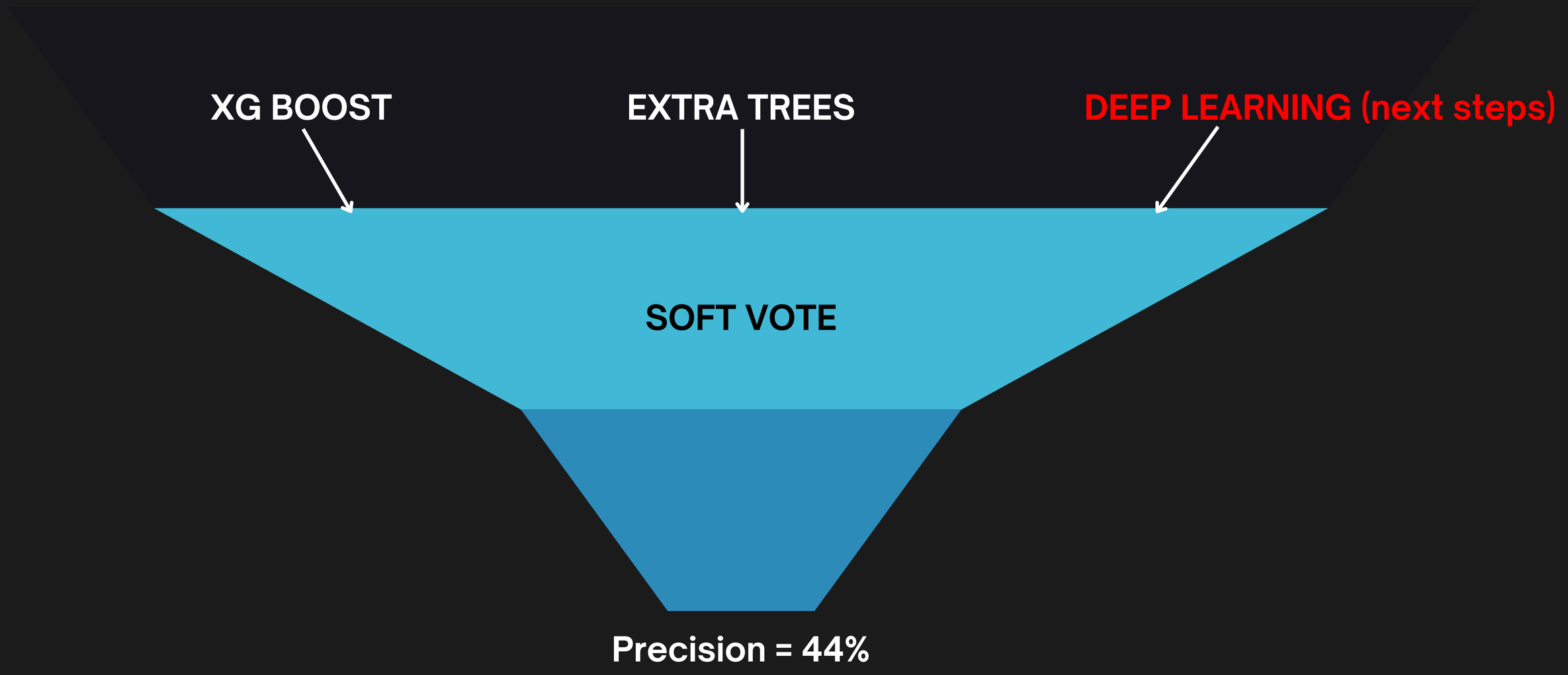


Comparison with baseline model

Performance of XGBoost, Extra Trees, Deep Learning vs baseline model



Voting classifier



Tech stack used

- Python
- Pandas
- Scikit Learn
- Seaborn & Plotly
- Tensorflow and Keras
- Streamlit

Limitations and future scope

- Limited factors
- Historical data
- Only wind curtailment
- Binary classification

- Include pricing, grid capacity, etc
- Forecast model
- Predict solar curtailment
- Regression

Thank you!

(please clap)