Emissions Modelling and Forecasting Using AI-Based Solutions

Matt Tierney, Arcus Power

Big Data In Electricity Markets

Big data and analytics are a critical component of electricity operations

Optimization of real-time dispatch

Understanding of system constraints

Forecasting of high demand events (coincident peaks)

Forecasting of prices for virtual trading, high price avoidance etc.

Electricity Sector Emissions

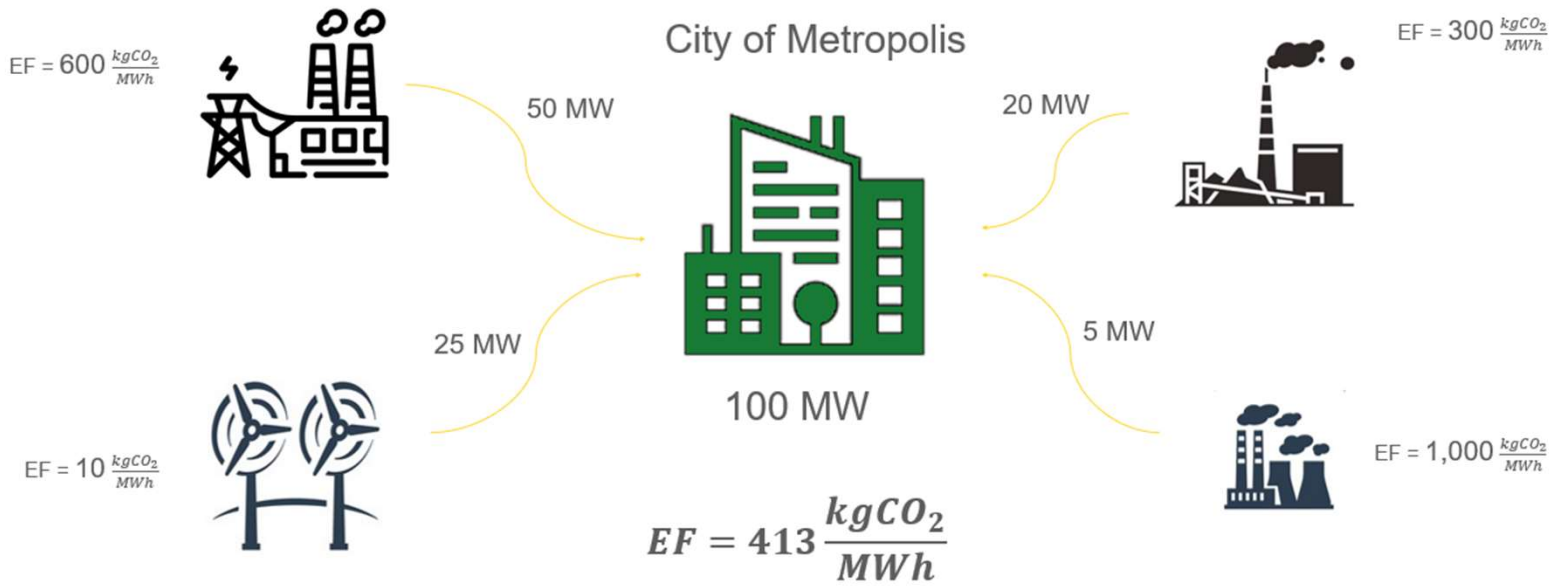
Goals of Decarbonization and “Net-zero”

However, advanced analytics are less frequent in the space of decarbonization and emissions tracking

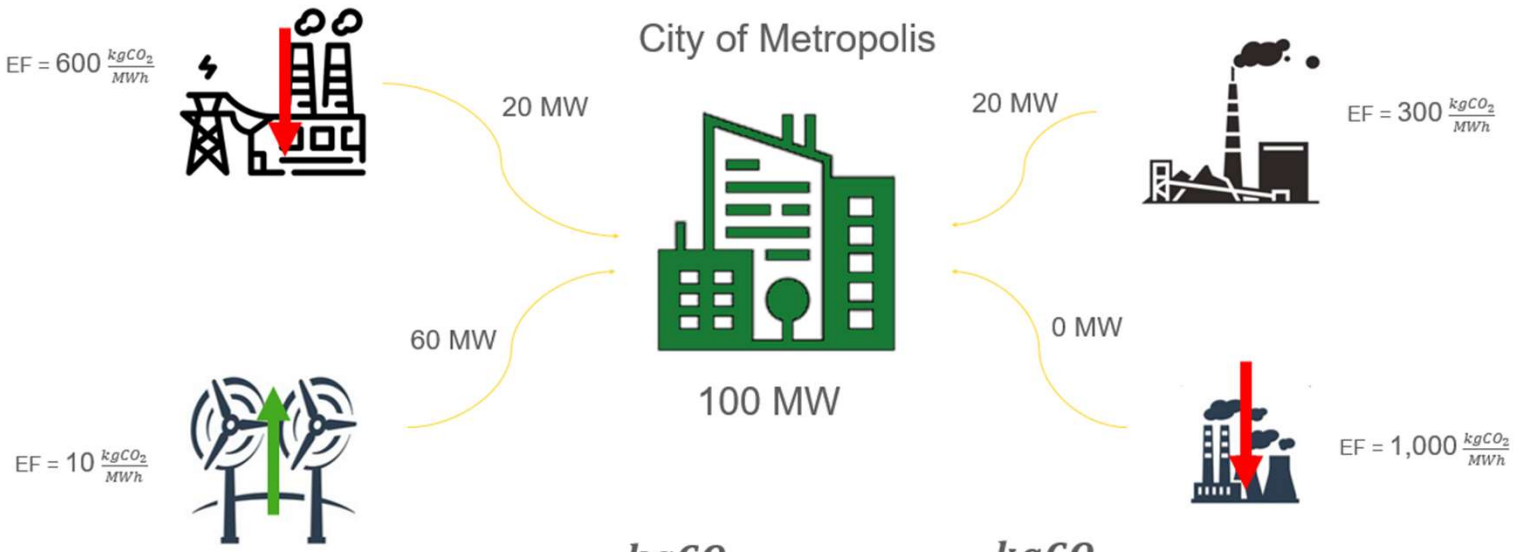
Regulations are typically based on **long-term, fixed** emissions *factors*

Low-carbon actions are considered in isolation, rather than considering their interactions with the larger system

Emissions Factors

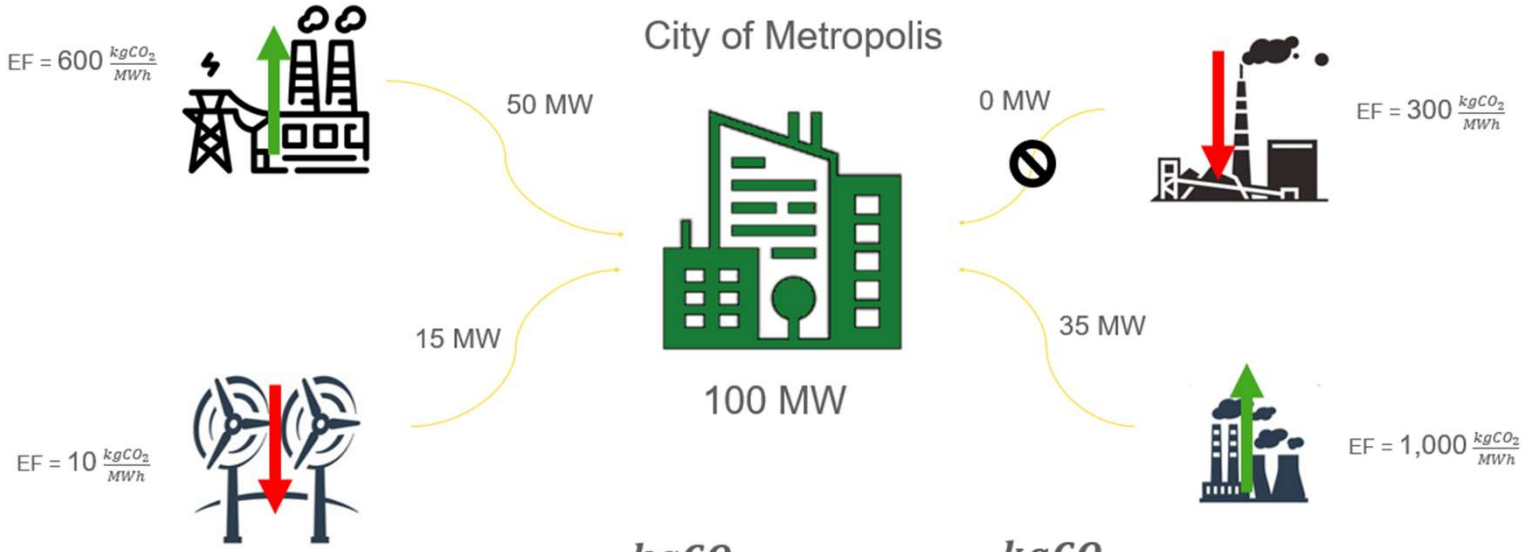


Emissions Factors



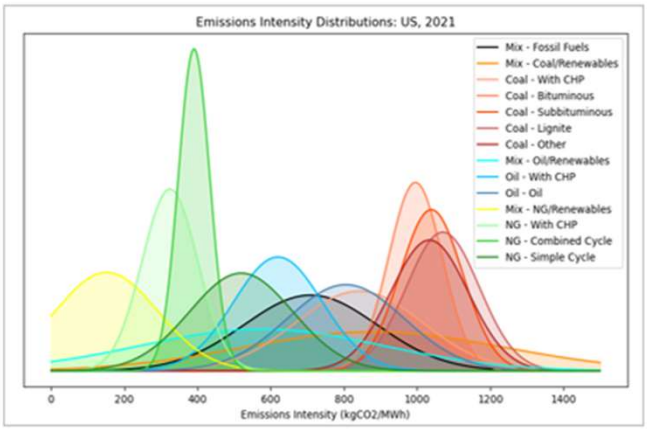
$$\sout{EF = 413 \frac{kgCO_2}{MWh}} \rightarrow EF = 186 \frac{kgCO_2}{MWh}$$

Emissions Factors



$$\cancel{EF = 186 \frac{kgCO_2}{MWh}} \rightarrow EF = 682 \frac{kgCO_2}{MWh}$$

How do we estimate real-time emissions?



$$EF = 450 \frac{kgCO_2}{MWh}$$

Emissions Response

Decarbonization through Real-Time Data

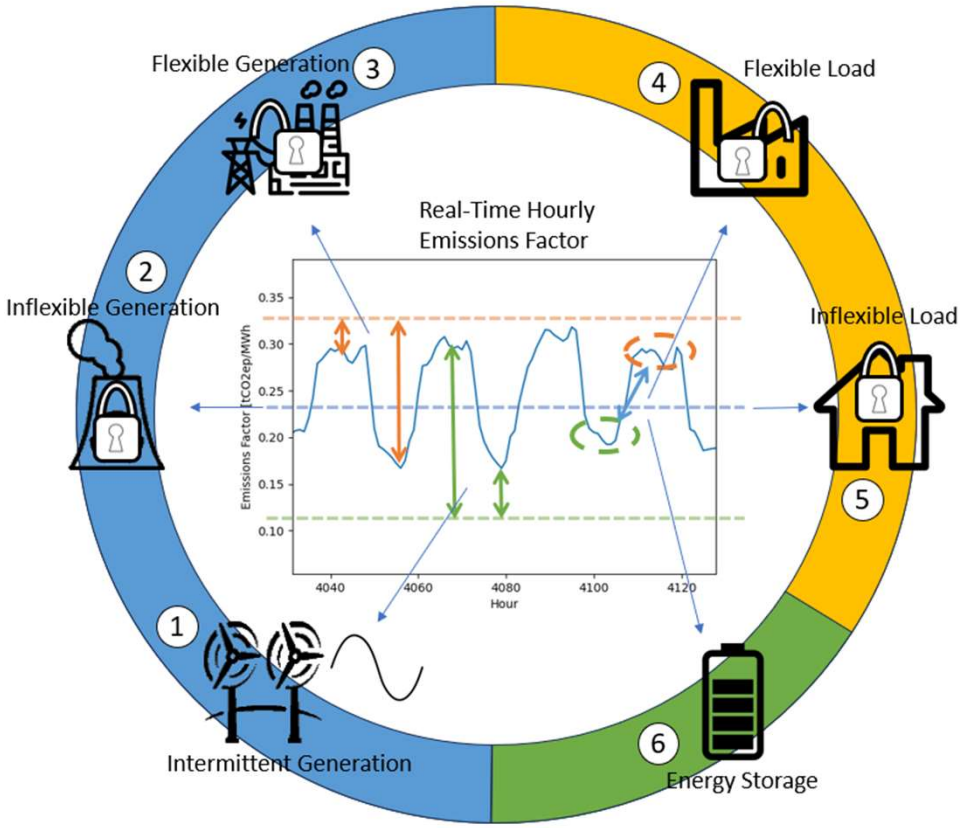
Understanding system emissions in real-time allows:

- The most accurate assignment of Scope II emissions
- Equitable distribution of regulated rewards and penalties
- *Smart* Consumption where demand follows emissions patterns
- Identification of system inefficiencies for targeted investment

Emissions Response

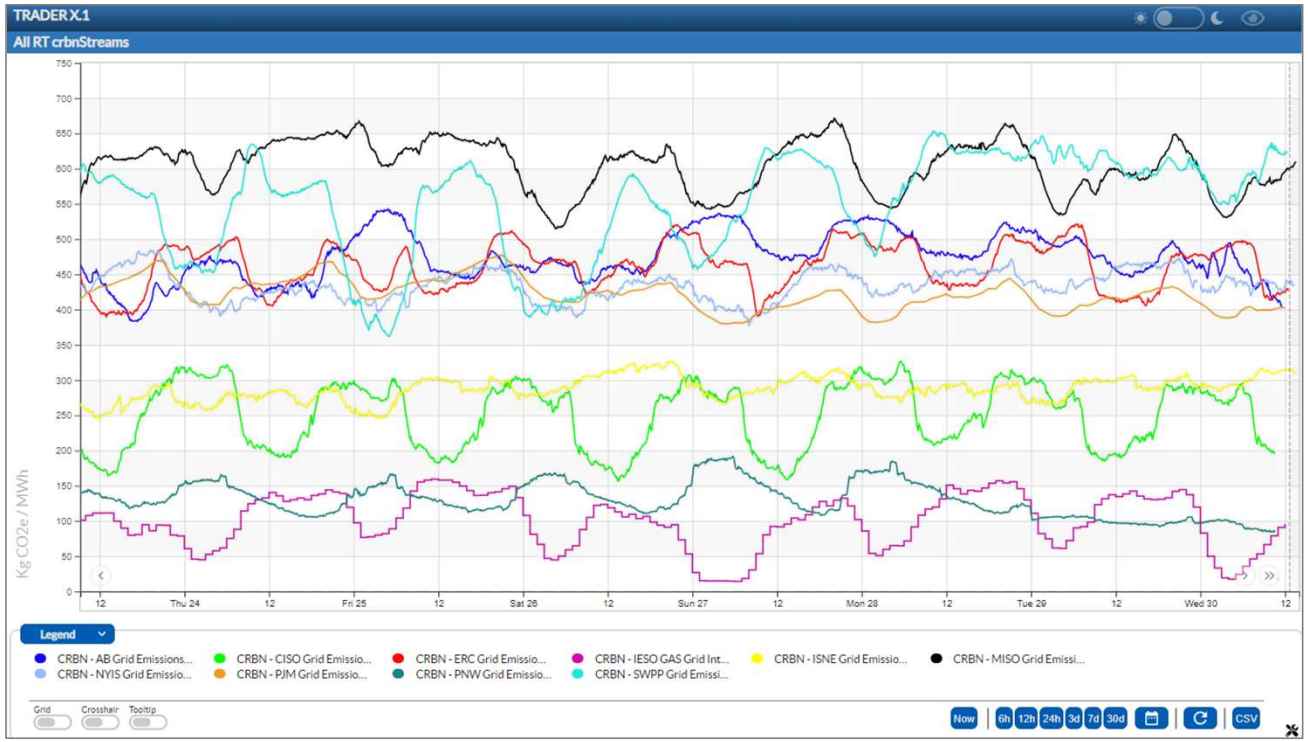
Emissions regulation based on real-time emissions factors brings benefits to key stakeholders in

- Generation
- Consumption
- Storage



Examples and Geographic Differences

By identifying different emissions patterns, we can guide low-carbon investment in the right directions



Emissions Response - Data

The application of “Emissions Response” depends on three key datasets

1) Real-time generation outputs from relevant generators

2) Emissions factors for relevant generators

3) Forecast emissions at grid-scale

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} AI Modelling

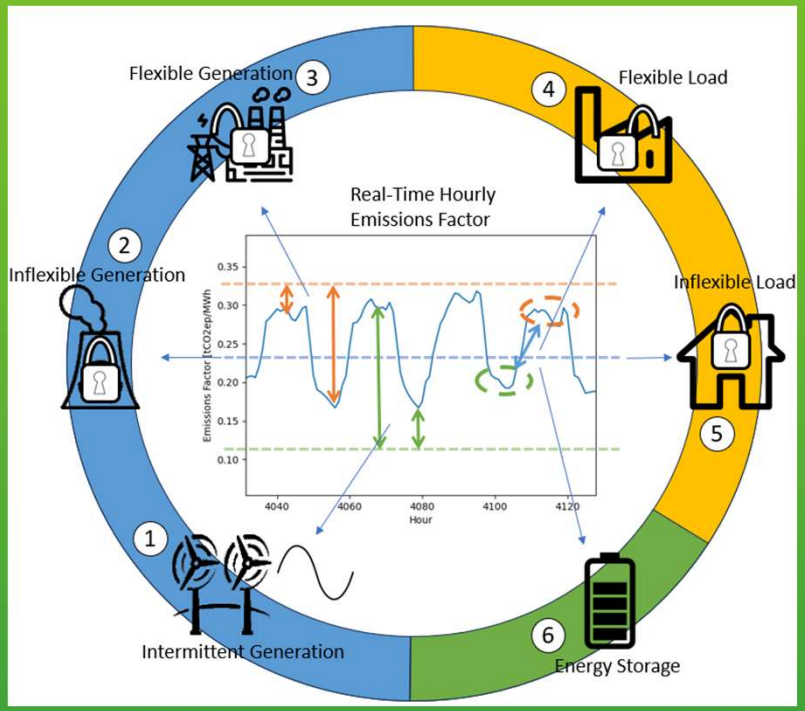
Targeting Grid-Wide Efficiency

Using ML models to extract patterns from data

Through statistical and AI models, we can extract complex patterns in price, demand, and grid-scale emissions

These patterns can be used to forecast, guiding short-term decision making

As well as guiding long-term change and investment in grids that benefits not only decarbonization, but **sustainability** and **efficiency**



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