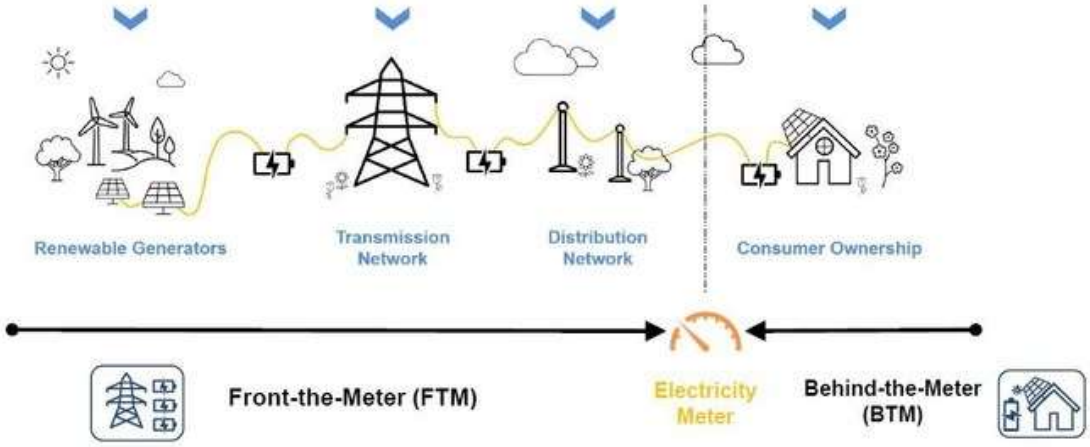
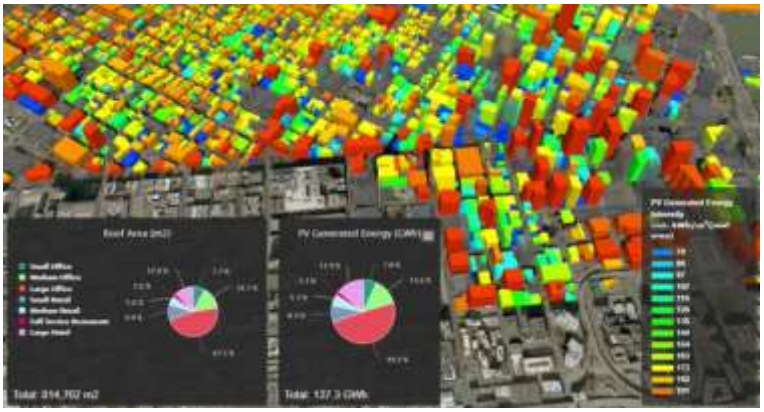
Sujet	**Data fusion for building demand forecasting**
Supervision	**Yves Marechal, Benoit Delinchant, benoit.delinchant@grenoble-inp.fr**
Partnership	**G2Elab, Energy Transition Observatory, GreenAlps**
Keywords	Demand Forecasting, Data fusion, Data science, Building simulation
Context /objective	This internship is part of a scientific approach to developing useful tools for the energy transition. We are particularly interested in facilitating the integration of intermittent renewable energies by improving production/consumption balancing services, such as flexibility services. To achieve this, we propose to improve methods and tools for predicting "Behind-the-Meter" energy consumption at city scale, and thus offer open and useful information to residents/citizens, energy operators and political decision-makers.  Source: IDTechEx (PRNewsfoto/IDTechEx) Numerous forecasting techniques exist, but they generally suffer from a lack of applicability. Indeed, they require specific data that is often difficult to obtain. In this context, the internship aims to analyze and implement a data fusion approach to consumption prediction. Models derived from both data science (machine learning / deep learning) and simplified physical phenomena recalibrated by data (data assimilation) will be studied. The case in point will be the prediction of consumption for part of the Grenoble peninsula.
Work	The course is divided into 3 parts: • The first part will be an in-depth analysis of generally available data, with a particular focus on Grenoble's Presqu'ile district. • The second part aims to identify the prediction methods and tools associated with each data source. Choices will have to be made for future developments. • The last part aims to initiate a data fusion approach, by aggregating data from heterogeneous sources. A proof of concept is expected at the end of the internship, showing that it is possible to build a consumption prediction with little information, and that the cross-checking of heterogeneous information reduces the prediction error. The GreEn-ER building will be used as a validation case.
Details	**1°) Analyze data availability** - The deployment of the 35 million Linky meters now offers very interesting potential for this study, but the measurements carried out are subject to the RGPD, which strengthens the protection of personal data. The Observatoire de la Transition Energétique (OTE) that we created at UGA gives us access to data from citizens willing to share it for scientific studies.

	- However, obtaining such consent cannot be systematized, so it is necessary to access other data. For example, spatial aggregation (e.g. load curve for a building with more than 10 dwellings) or temporal aggregation (monthly or daily index instead of a load curve with a 30-minute interval). GRDs (distribution network operators) such as ENEDIS or GreenAlp in Grenoble, can use data to operate the network. - Finally, other sources of data can be used to estimate consumption, based on physical and statistical models that take into account the nature and use of buildings, energy performance diagnoses (DPE: https://data.ademe.fr/datasets/dpe-france), Standardised Thermal Study Summaries (RSET), Grenoble's 3D building model, etc. **2°) Analysis and selection of existing prediction tools** - A first type of exploitable tool is based on artificial intelligence methods. If the history of a time series is available, methods such as recurrent neural networks (eg. LSTM) are powerful for predicting future consumption over different time horizons (from a minute to several hours). - A second type of tool is based on building energy behavior equations, parameterized by geometric and physical properties and usage (eg. CityBES, CityEnergyAnalyst, Teaser, Better, Moped, CREST…). **3°) Data fusion** Applied to the Presqu'ile area (Cambridge district and GreEn-ER building in particular), the aim will be to validate different modeling approaches based on the data used, which are sometimes very approximate, to compare them with actual data, and to show that combining heterogeneous information can reduce uncertainty and improve the accuracy of predictions. For example, we can recalibrate a coarse model using monthly consumption data (data assimilation). We can compose a neighborhood model using heterogeneous approaches for different buildings, and deduce a missing model by total substitution... This internship will contribute to the production of a consumption prediction tool that allows, in particular, a spatial visualization of demand, as can be done here for photovoltaic potential. Source : cityBES 
Skills required	Python programming, Energy modeling, Research skills, Collaborative work, Taking initiative. French B1.