POLITECNICO
MILANO 1863

openmod open energy modelling initiative

Data-Driven Demand Estimation in Electrification: Harmonized dataset and Machine-Learning Approach to Enhance Rural Energy Planning

Authors: Alessandro Onori, Nicolò Stevanato

Contact Author: Nicolò Stevanato

26/03/2024

SESAM– Sustainable Energy Systems Analysis and Modelling

Need for Harmonized Data Sources

Challenges in data collection for load demand characterization of non-electrified areas

High Cost and Complexity of Data Collection

*Collecting data in non-electrified areas is not only **economically expensive** and complex but also faces **sociocultural barriers** and **reluctance to participate**, complicating surveys and possibly **limiting the accuracy** of energy demand estimates crucial for system sizing.*

Lack of Data Persistence and Reuse

*Often, load demand data are discarded after a single use, leading to **redundant efforts** across various entities. This inefficiency results in **resource wastage and delays**, affecting development in nations.*

Diversified and Non-harmonized Data Sources

*The collection of data at **different granularities** is complex, requiring exploration of various often non-harmonized sources.*

Approximately **20 references** needed to collect **61 load profiles** of rural mini-grids [1]

On-field picture of workshops and data collection activities

Source: [1] https://doi.org/10.1109/ACCESS.2023.3294841

Need for Harmonized Data Sources

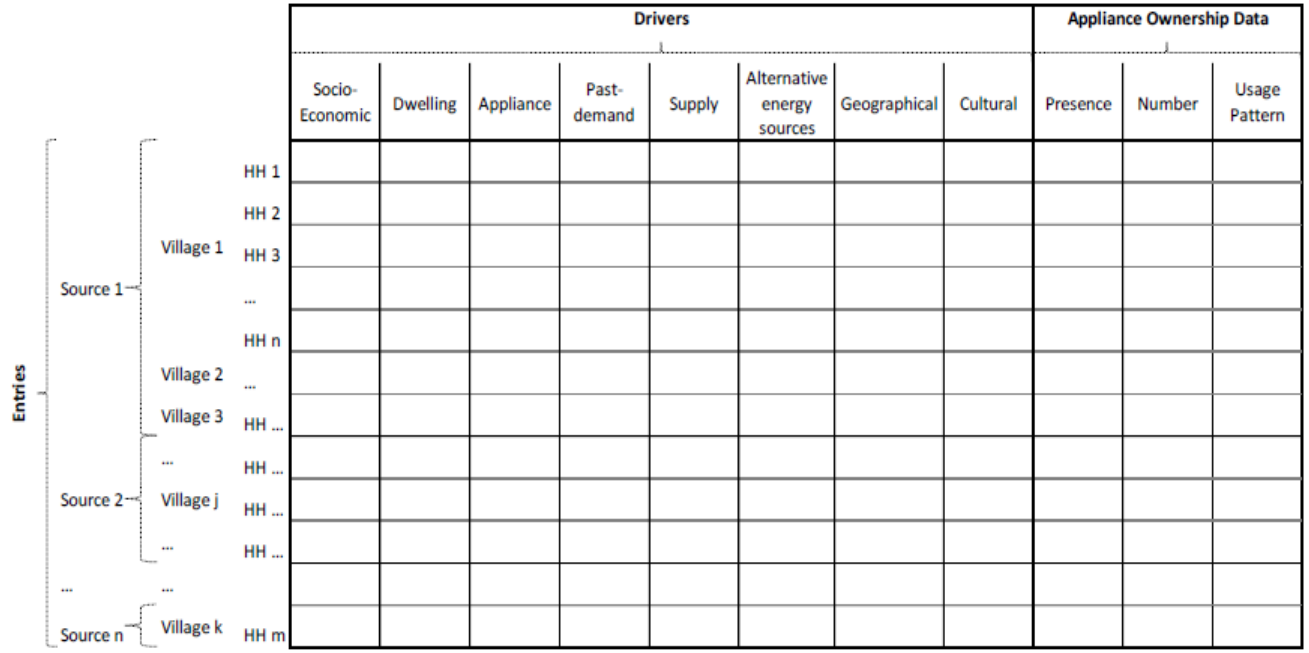
Strategic approach to harmonized data collection and analysis

1. **Review of the scientific literature** to identify the **main drivers** that influence the electricity demand of a community

   39 papers reviewed
   8 final drivers classes

2. Different data sources has been **harmonized and combined** into the final **proposed structure**

Structure of the proposed database



NEW

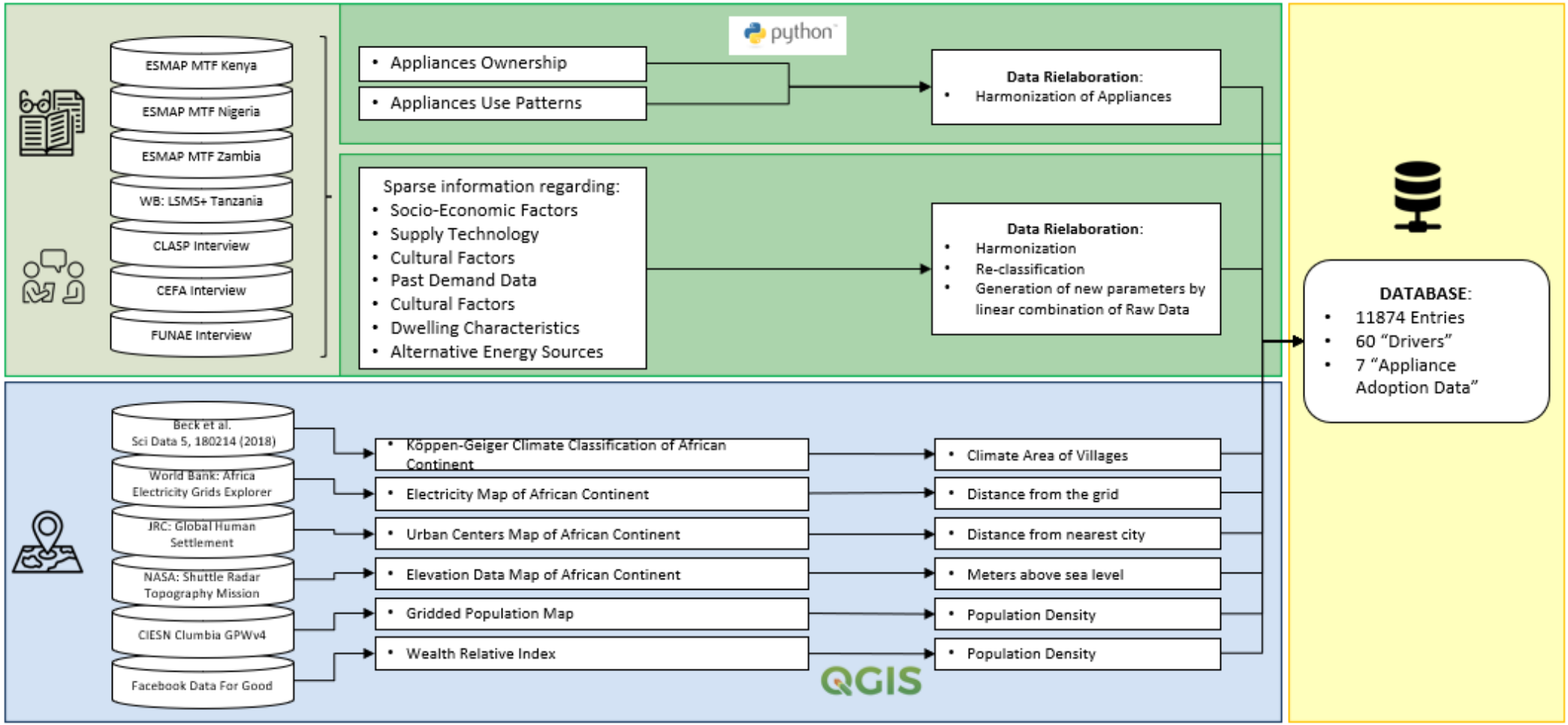
Comprehensive Data Integration
*Supports storing and analyzing **mixed georeferenced**, **socio-economic**, and load demand data at the local scale*

&

User Data Contribution
*Enables **user-driven data uploads**, enriching the platform's data pool*

Database Construction

Database construction procedure from raw data collection through Python processing to spatial analysis in QGIS, culminating in a robust energy access database.



Source: http://dx.doi.org/10.2139/ssrn.4562387

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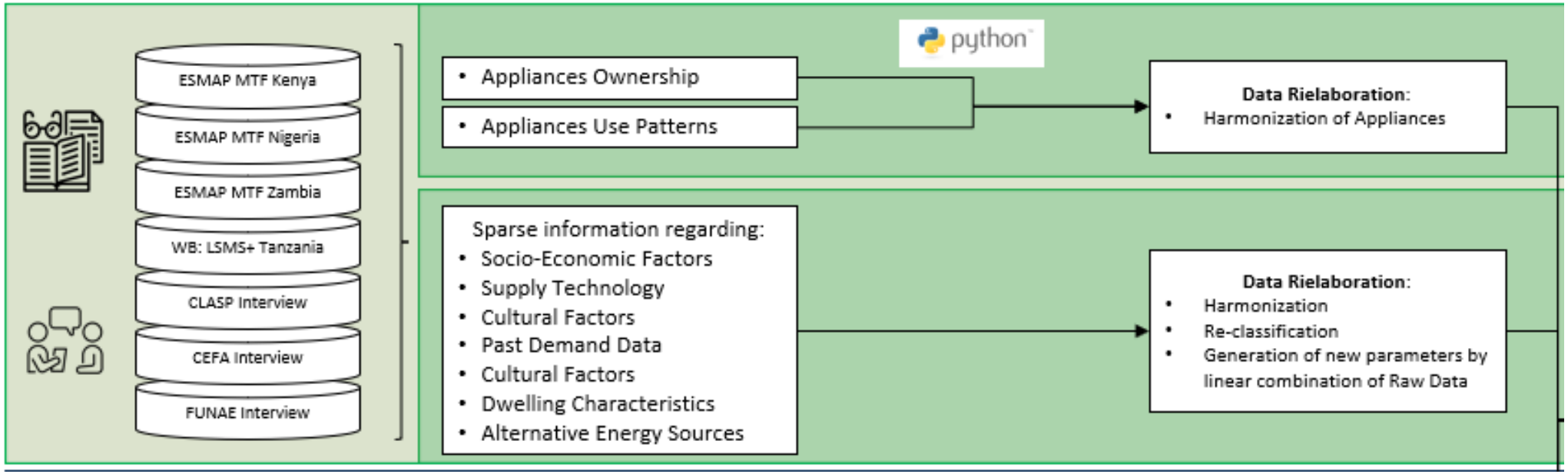

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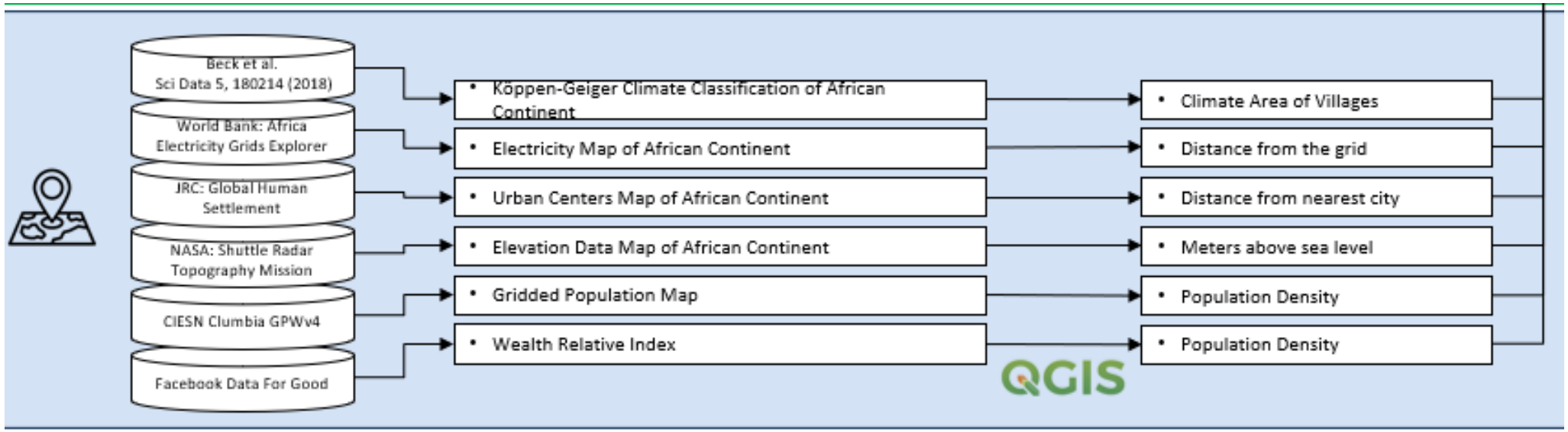

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Predictive Algorithm

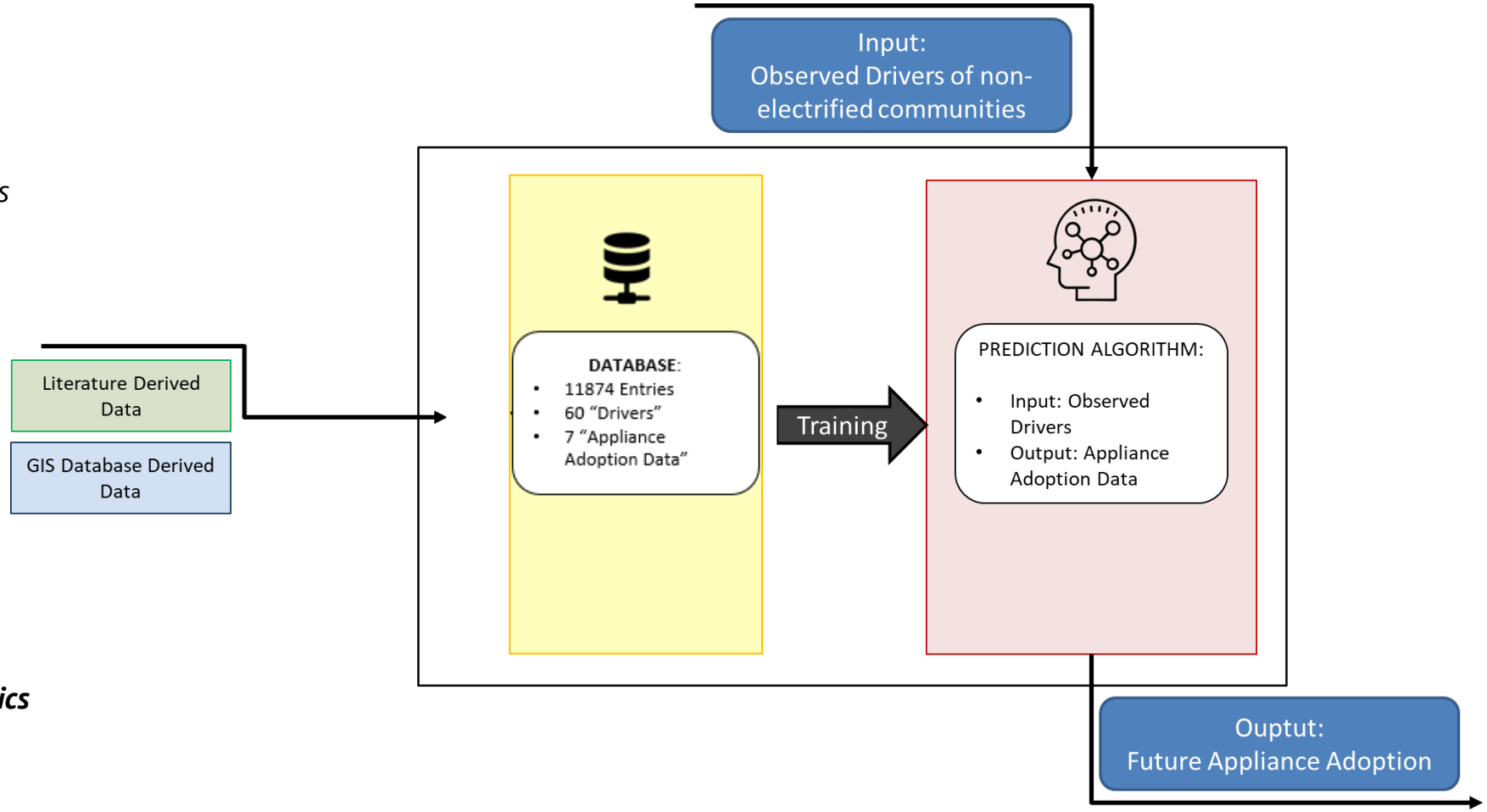
Text

Blodgett et al., 2017

*«If **data sets** are **widely available**, these results suggest that mini-grid developers can use them to **better predict consumption** than the common survey approach.»*

Fabini et al., 2014

*«…in this approach is the assumption that localities that **share socioeconomic characteristics** will also have **similar demand for electricity services** and similar ability to pay for them.»*



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