

Using Artificial Intelligence for Energy Code Compliance Verification

Tool for faster, more accurate code compliance verification with Generative AI

USING AI FOR BUILDING ENERGY CODE COMPLIANCE VERIFICATION

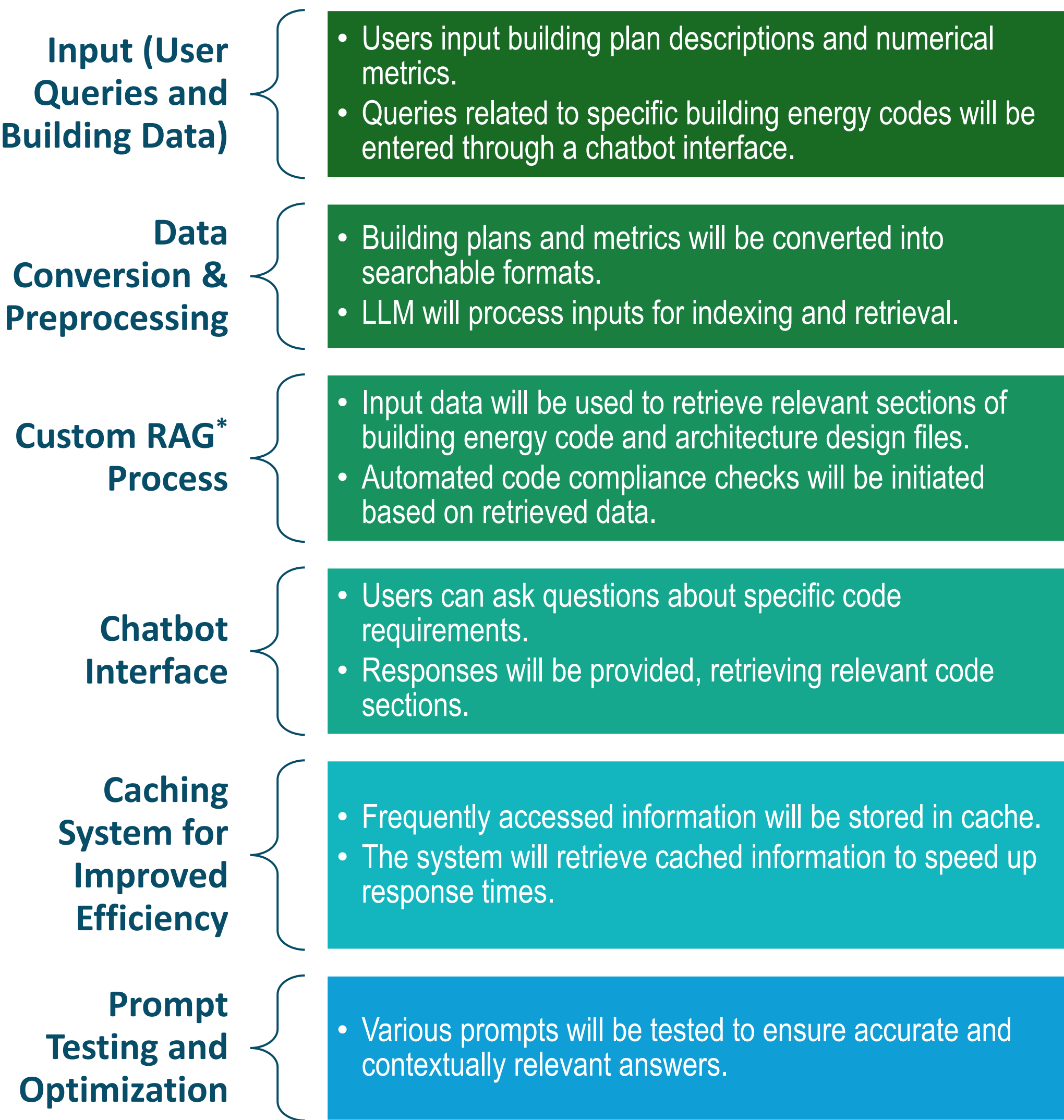
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BACKGROUND AND IMPACT

- Objective**
- This project uses Generative AI (Gen-AI) to automate code compliance verification making it faster and more accurate
- Background**
- Manual verification of building energy code compliance is complex, resource intensive and can result in lost opportunity to save energy.
 - Advanced Gen-AI tools like ChatGPT are becoming popular and have big potential in building research and the industry.
- Impact**
- This project supports the DOE's goal of cutting energy use in buildings. Better code compliance saves energy and reduces emissions.
 - It helps local governments, building owners, and contractors by making it easier to follow energy codes, speeding up approvals, and lowering costs.
 - While code compliance is just the start, these tools could also be used for workforce training, control support, and building energy model support in the future.

METHODS

The tool development methods process steps are outlined in the figure below.



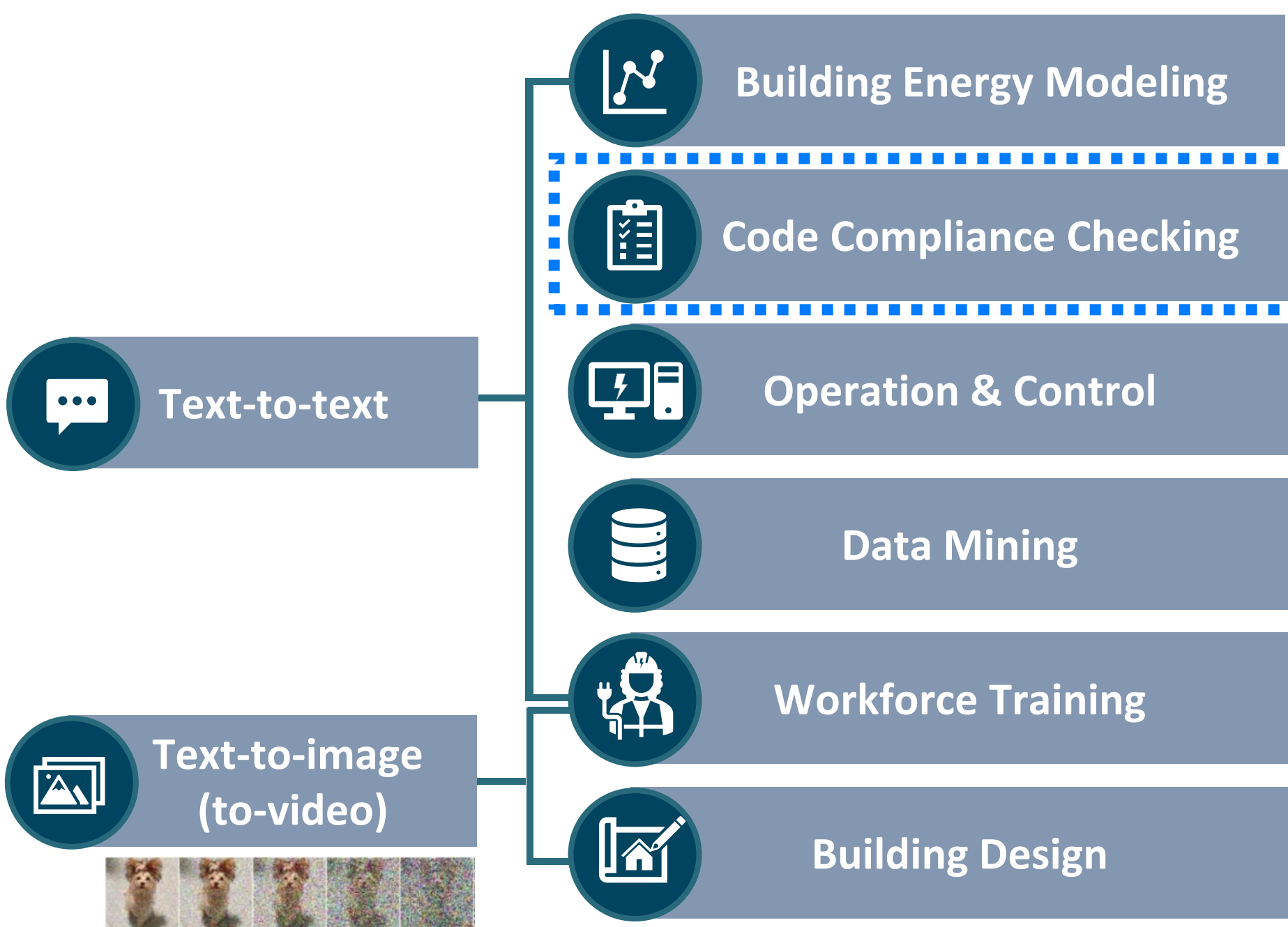
KEY PRODUCTS

- The project will develop a Building Energy Compliance Checking Assistant Tool with an easy-to-use interface, along with possible features for reporting and visualizing results. This tool helps simplify the process of checking building energy codes by automating it and making the results easy to understand.

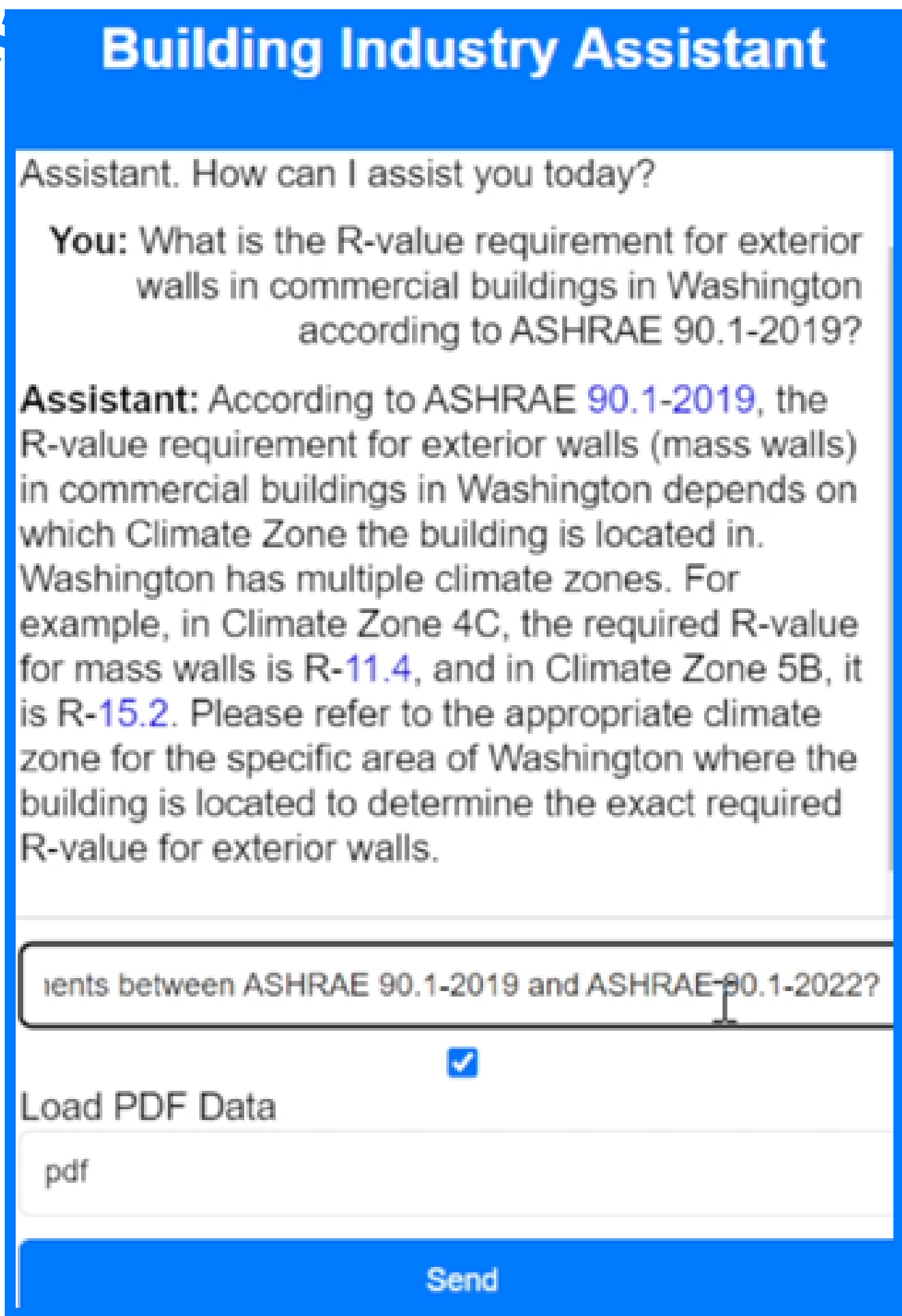
CONCLUSION

- Addressing the Key Challenge**
- It will explore the potential of using customized pre-trained models, like GPT-4o or Llama 3, and focuses on improving accuracy and efficiency through prompt engineering, RAG, and fine-tuning.
 - It will explore the challenge of accurately extracting important data from tables and figures within building energy codes, ensuring the right information is applied during checks as a long-term goal.
- Impact of the Project**
- If successful, the project will save time and resources, helping more buildings meet energy efficiency standards.
- Advancing the BTO's Mission**
- The tool supports DOE's mission by automating compliance checking, making it easier to follow energy codes. Ultimately, easier access to energy code information will contribute to sustainability efforts.

Application of Generative AI in Building Industry



The application of generative AI tools includes text-to-text and text-to-image (or video), across various building-related tasks. This work of building energy code compliance checking is a start point.



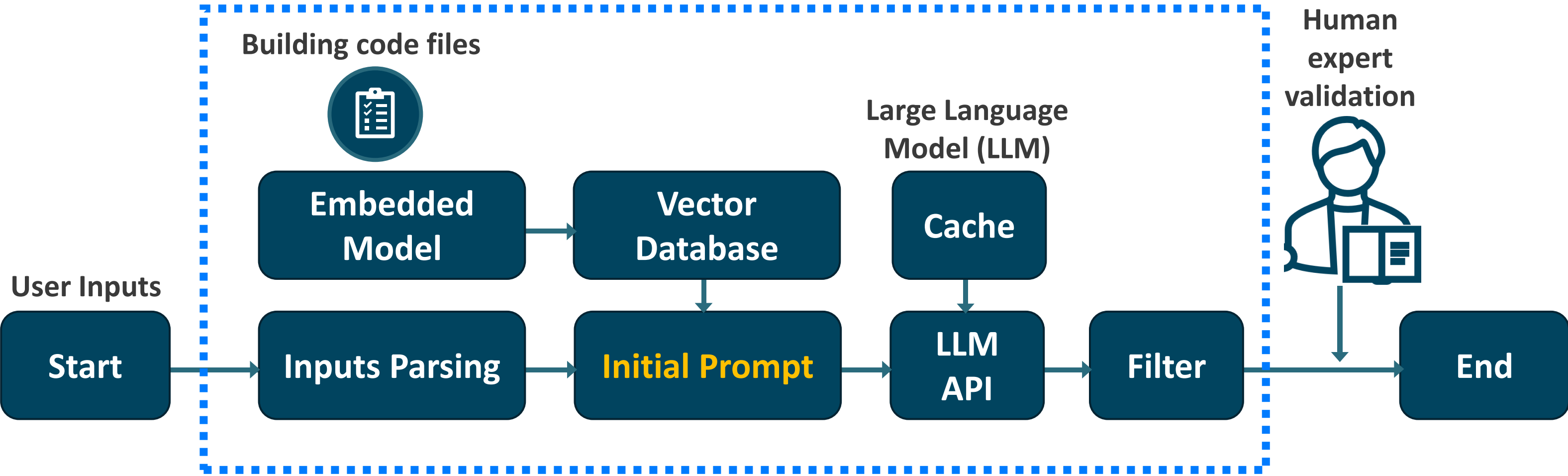
A demo developed and tested to locate the R-value requirements for Washington State from the ASHRAE 90.1-2019 version, streamlining the process of retrieving specific building code information.

Some Available Pre-Trained Models

Model families	
Platforms	

A variety of pre-trained models are available, which can be accessed through platforms like Microsoft Azure OpenAI API as paid options, or through open-source models from communities like Hugging Face.

Application User Interface (APP UI) Process



*This customized Retrieval-Augmented Generation process is designed for efficient building energy code compliance checking. It starts by parsing input documents such as building plans and energy codes, then transforms them into vector representations using an embedded model. The system retrieves relevant code sections from a vector database, generates an initial prompt, and leverages large language model (LLM) via an application user interface (API) to produce detailed compliance checks.



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