



# IDEA 2021

Powering the Future: District Energy/CHP/Microgrids

Sept. 27-29 | Austin Convention Center | Austin, Texas



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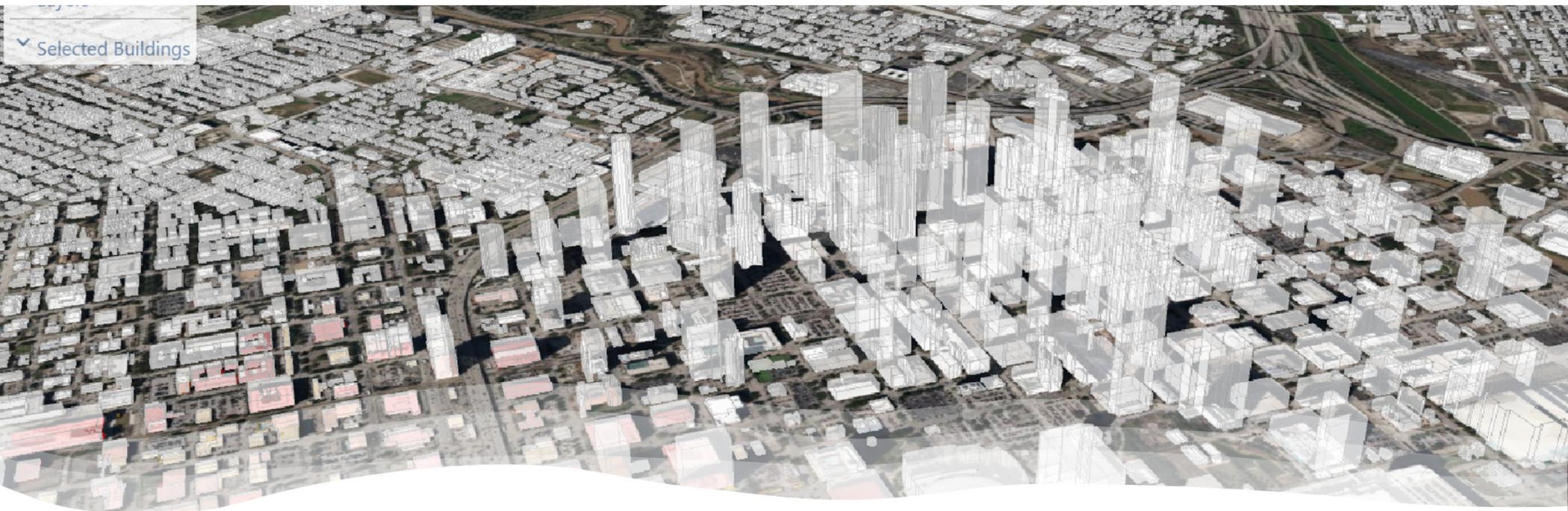
# An Innovative Software Tool for Non-technical Users to Identify Business Opportunities for District Energy and Community Microgrids

Gavin Dillingham, Ph.D. and Carlos Gamarra, P.E., PhD



**HARC**

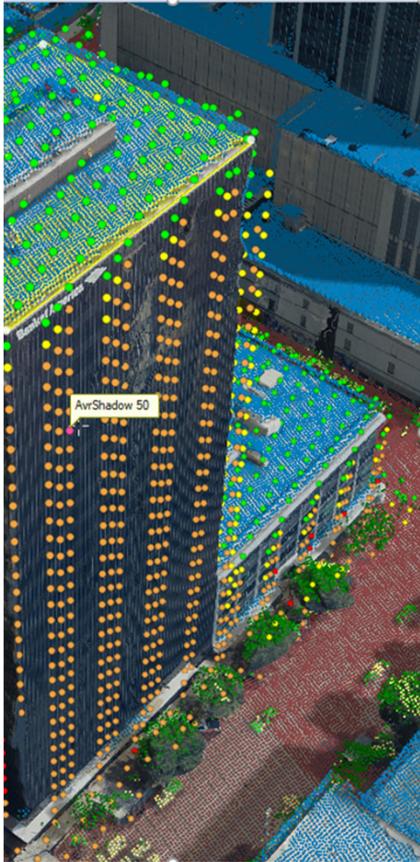
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# ABOUT THE PROJECT

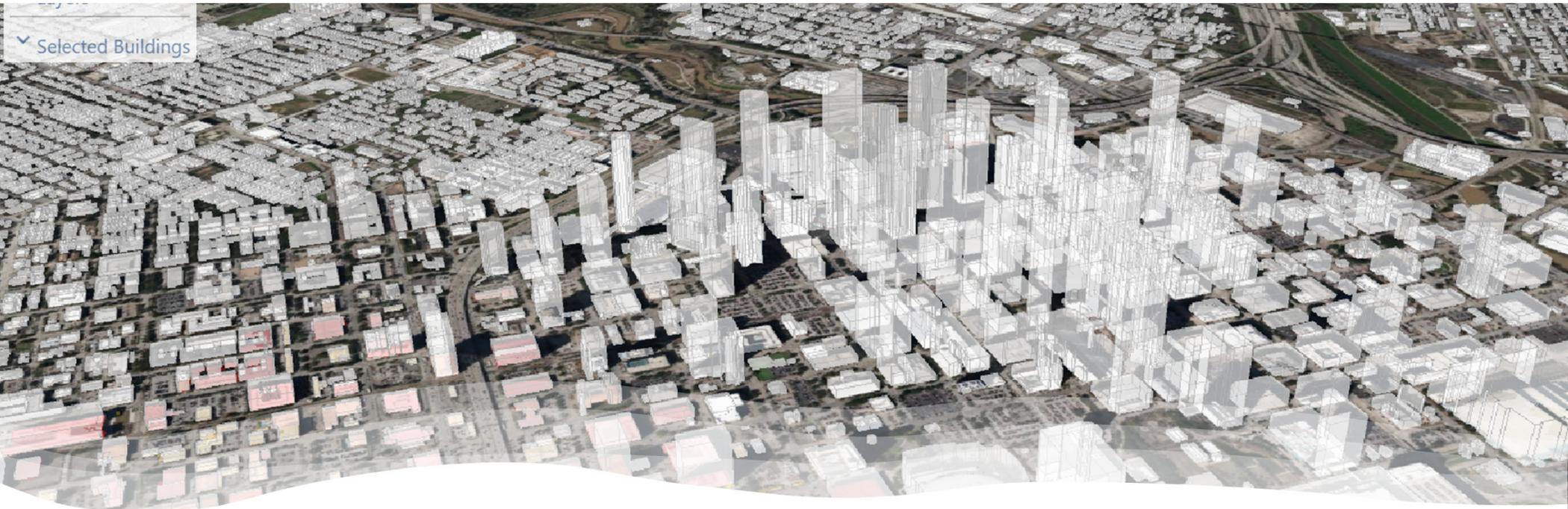
# ABOUT THE PROJECT

- Software tool development project oriented to feasibility analyses (FAs) for district energy and community microgrids
- Funder: DOE's Advanced Manufacturing Office
- Duration: 09/2020 -11/2023
- Lead by HARC, partnering with UH and Fugro



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# PROBLEM DESCRIPTION

QUALITY AND QUANTITY ISSUES

# PROBLEM RATIONALE: QUANTITY ISSUE

- District energy and community microgrids have the potential to provide resilience and decarbonize.  
**But do they have the potential to fulfill the financial goals of their investors?**
- Investing is a complex decision due to the **high initial investment** and **risks** associated with the long project lifecycle.
- The number of FAs developed is **limited by the low level of independence investors have**.
  - **TECHNICAL BARRIERS** : lack of expertise on how to configure the systems and how that configuration would affect the economics.
  - **ECONOMIC BARRIERS**: low interest in spending money on studying solutions that might be feasible, or not.
- **More feasibility analyses of business opportunities might lead to an increasing level of adoption of community microgrids and district energy systems.**



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# PROBLEM RATIONALE: QUALITY ISSUE

- Singularities of FA for community microgrids and district energy systems
  - Investors are rarely involved at this stage due to their lack of technical expertise, but are always interviewed about their goals
  - **HIGH NUMBER OF POTENTIAL SOLUTIONS:** Each microgrid project has dozens of potential combinations of technologies, sizes and manufacturers. Power or thermal distribution system planning adds complexity.

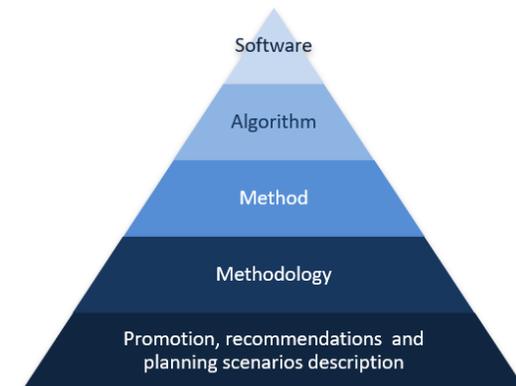
$$MaxPL = \sum_{i=1}^N (N - i) = \frac{N^2 - N}{2} = \frac{6^2 - 6}{2} = 15 \quad Search\ Space\ Size = s^{MaxPL} = 3^{15} = 14,384,907$$

- **TIME CONSUMING:** number of potential solutions cut down to expedite the analysis.
- **LOW-COST ANALYSIS:** sometimes provided for free to open the conversations with the client and to gain his/her trust.
- Decision-making processed in engineering are unconsciously biased. <sup>1</sup>
- This dynamic leads to a **limited exploration of the potential solutions.**

[1] <https://appel.nasa.gov/2018/04/11/mitigating-cognitive-bias-in-engineering-decision-making/>

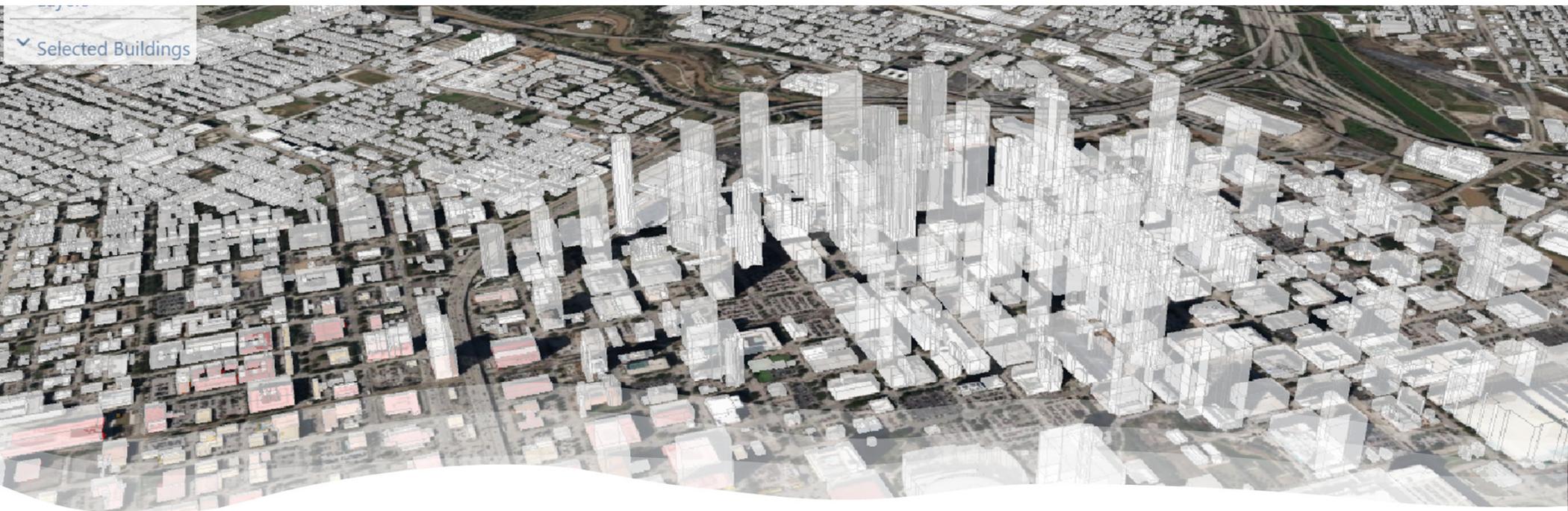
# PROBLEM DEFINITION

- There is a **need for more advanced feasibility analysis tools and methods** :
  - Able to **expedite the study** of business opportunities in this market.
  - Able to **explore thousands of configurations** and scenarios in an agile and timely manner.
  - Able to **provide more detailed information on the economics**, allowing investors to develop a personal point of view prior to involving more technical entities in the process.
  - Able to **quantify the potential impact of uncertainties** on the long-term profitability of the project.
  - **Accessible both to engineers and users with limited or no engineering background.**
  - Leveraging **artificial intelligence to minimize biases and risks** of overlooking solutions that might improve the economics of the project.



Do you agree with the problem definition presented?

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# TOOL DESCRIPTION

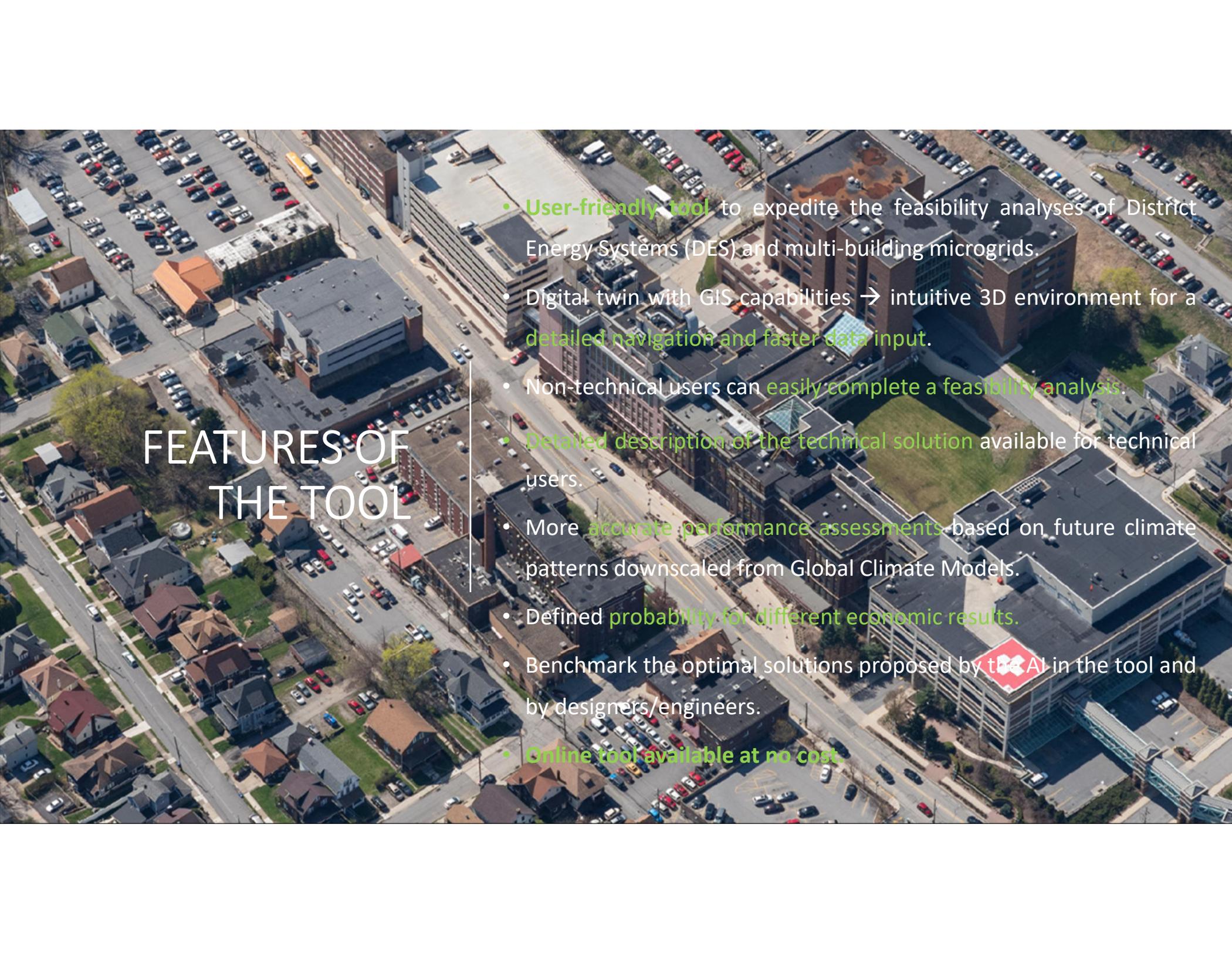
# GOALS OF THE TOOL

## DEVELOPMENT OF AN AGILE FEASIBILITY ANALYSIS TOOL FOR NON-TECHNICAL USERS, PROVIDING ADVANCED FEATURES FOR TECHNICAL USERS TOO

To advance the state of the art of feasibility analysis methods for community microgrids and district energy by:

1. **Eliminating the cost barriers at the feasibility level**, increasing the interesting of investors on these systems.
2. **Reducing the engineering skills required by the users**: An investor with clear economic goals should be able to check if a district energy is a profitable solution without involving third companies.
3. **Integrating an innovative method** adapted to this planning problem into a cloud-based tool.
4. **Benchmarking the solutions found by the AI with those defined by a technical user**, identifying the obstacles to fulfill the goals of the project.

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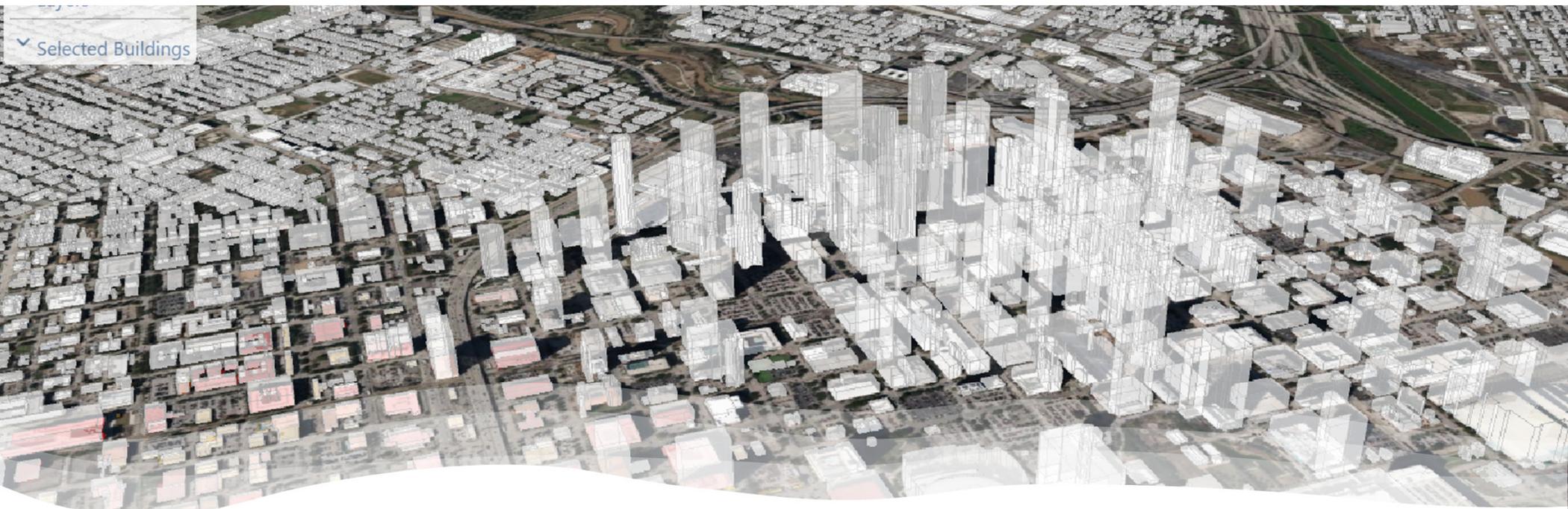
# FEATURES OF THE TOOL

- **User-friendly tool** to expedite the feasibility analyses of District Energy Systems (DES) and multi-building microgrids.
- Digital twin with GIS capabilities → intuitive 3D environment for a **detailed navigation and faster data input.**
- Non-technical users can **easily complete a feasibility analysis.**
- **Detailed description of the technical solution** available for technical users.
- More **accurate performance assessments** based on future climate patterns downscaled from Global Climate Models.
- Defined **probability for different economic results.**
- Benchmark the optimal solutions proposed by **the AI** in the tool and by designers/engineers.
- **Online tool available at no cost.**

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Do you find these features interesting?

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# SURVEY RESULTS

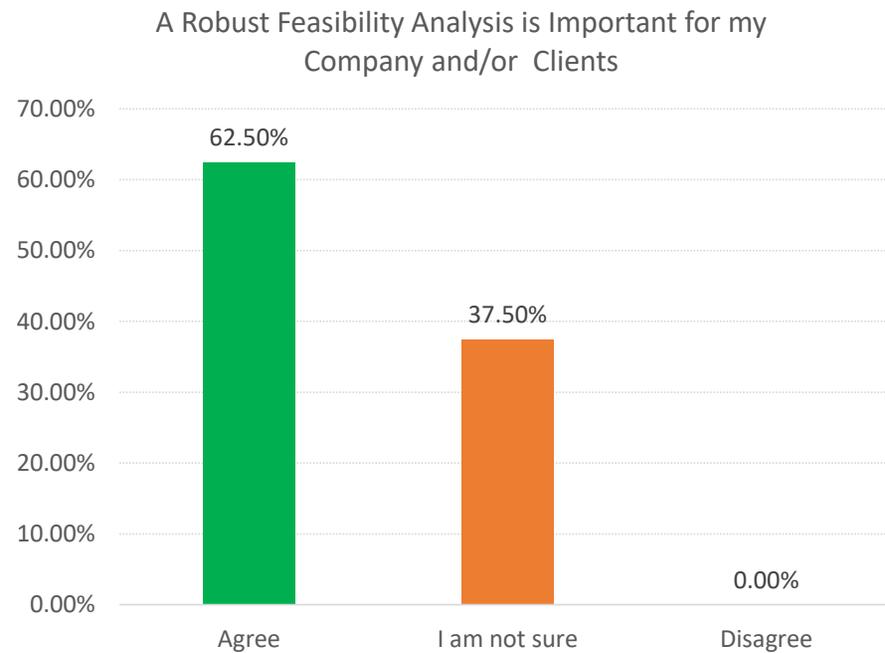
ONLINE POLL AND SURVEY RESULTS COMPARISON

# A Robust Feasibility Analysis is Important for My company and/or Clients

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# SURVEY RESULTS

- FAs are recognized as a relevant stage of the development a district energy or community microgrid.



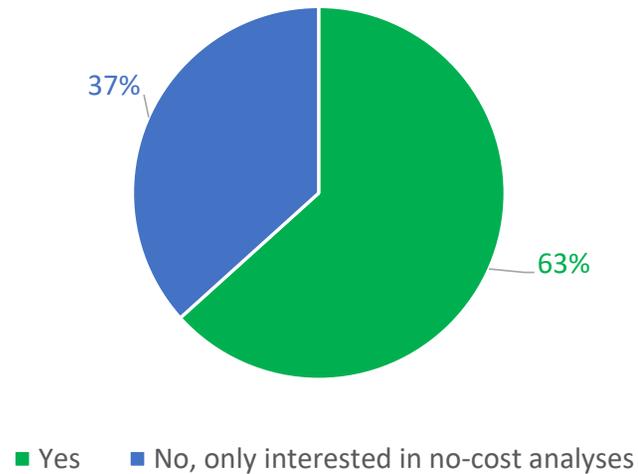
Are your company and/or clients open to pay for a feasibility analysis?

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# SURVEY RESULTS

- 63% of the respondents, or their clients, would be open to pay for a feasibility analysis of a district energy or a community microgrid

My Company and/or Client is Open to Pay for a Feasibility Analysis

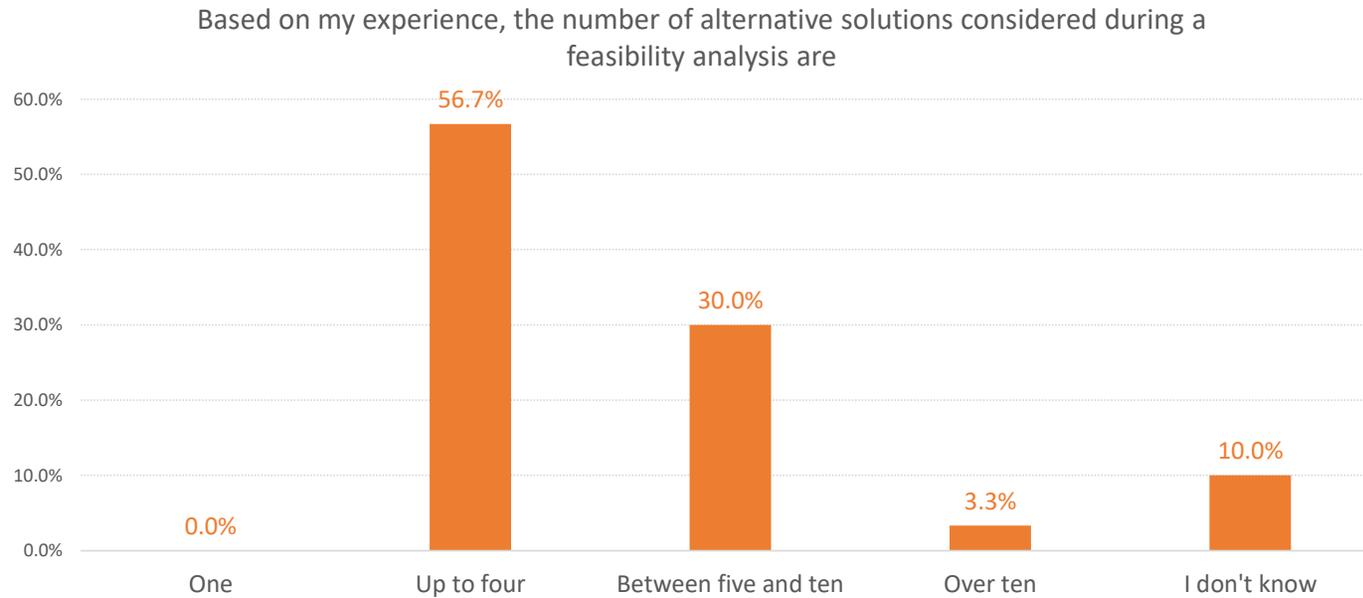


Based on my experience, the number of alternative solutions considered during a feasibility analysis are

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# SURVEY RESULTS

- According to the respondents, over 56% of the feasibility analyses consider up to four alternatives

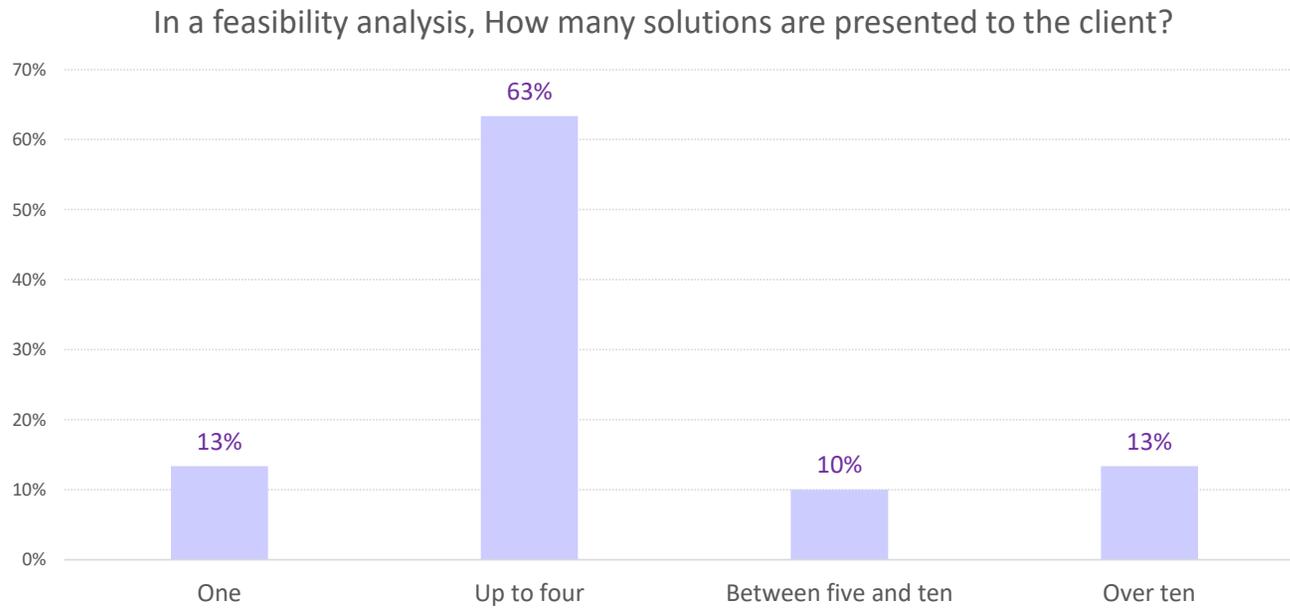


# In a Feasibility Analysis, How Many Solutions are Usually Presented to the Client?

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# SURVEY RESULTS

- According to the respondents, up to four solutions are presented to the client as a result of a feasibility analysis.



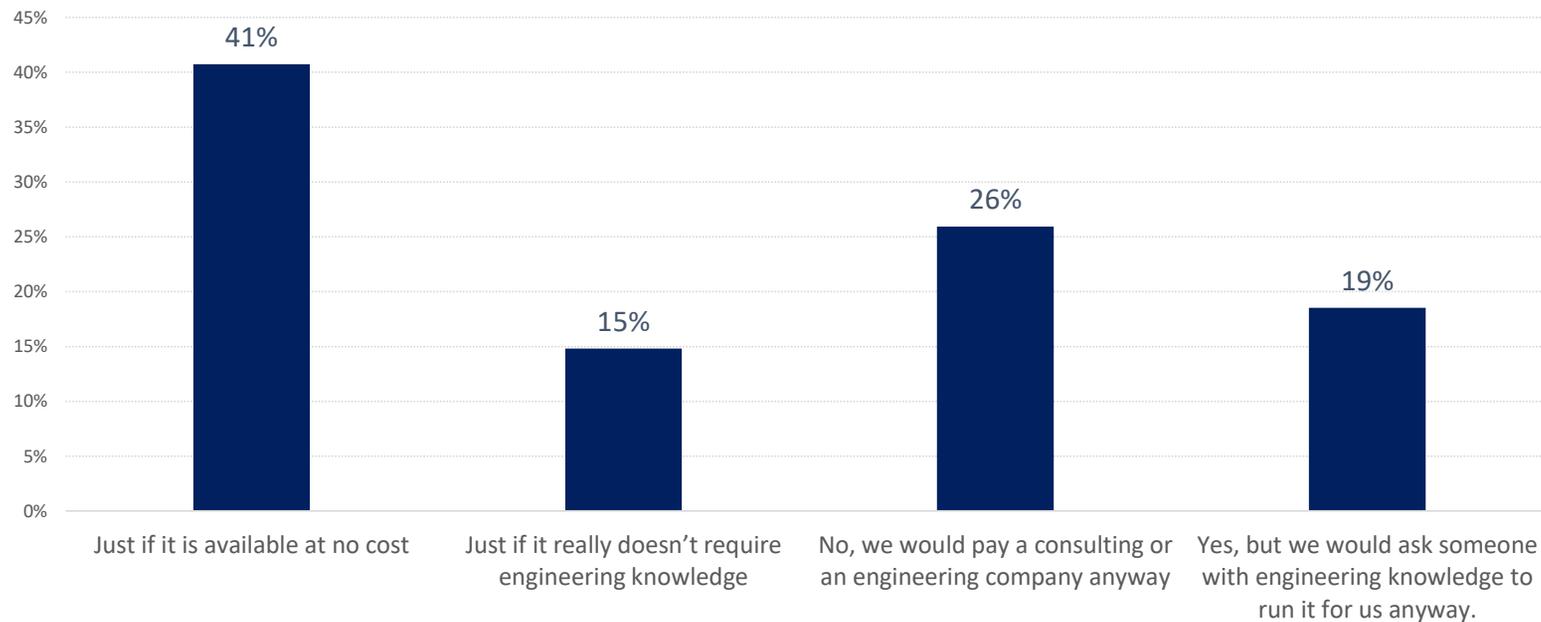
Are you interested in a no-cost feasibility analysis tool requiring no technical knowledge?

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# SURVEY RESULTS

- According to the respondents, the cost factor is relevant to adopt the tool.

Are you interested in a no-cost feasibility analysis tool of district energy and community microgrids requiring no technical knowledge?



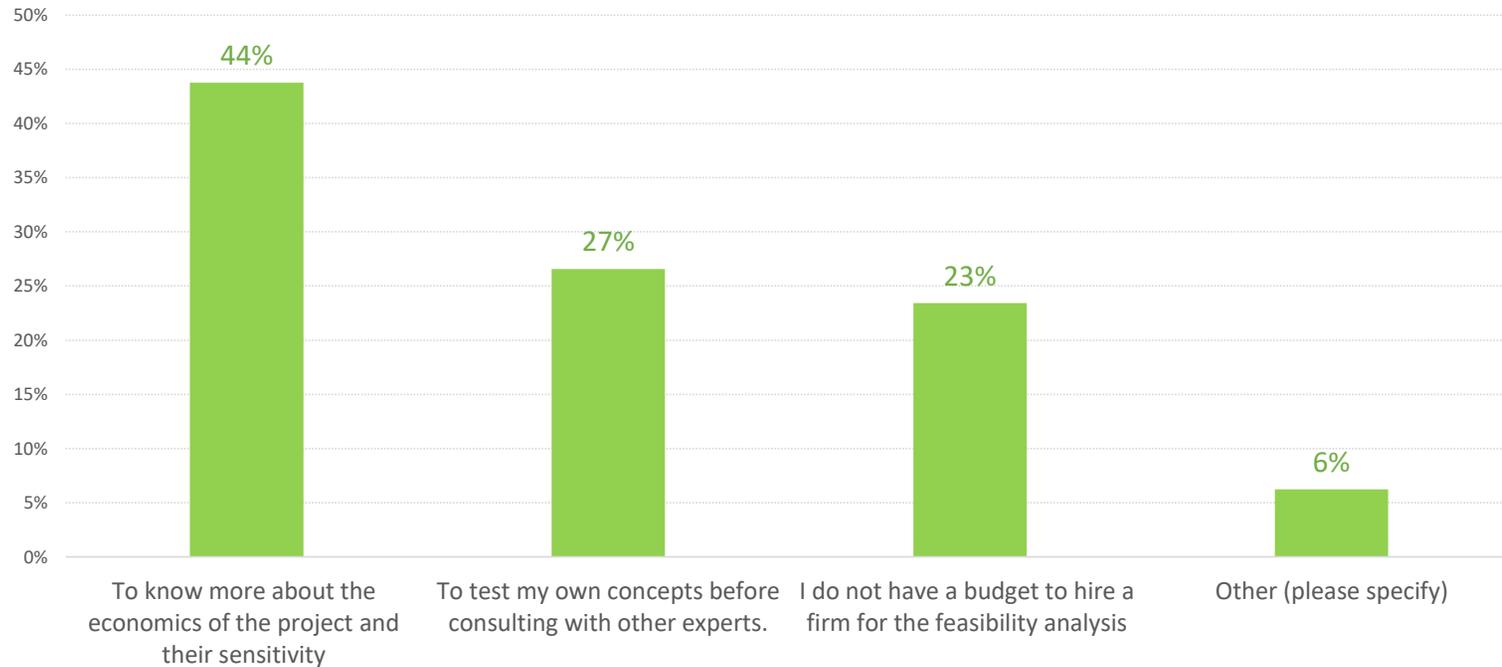
What would be your reason(s) for using this tool? Please mark as many as apply

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# SURVEY RESULTS

- Respondents have shown interest in studying the economics and testing their own concepts

What would be your reason(s) for using this tool? Please mark as many as apply



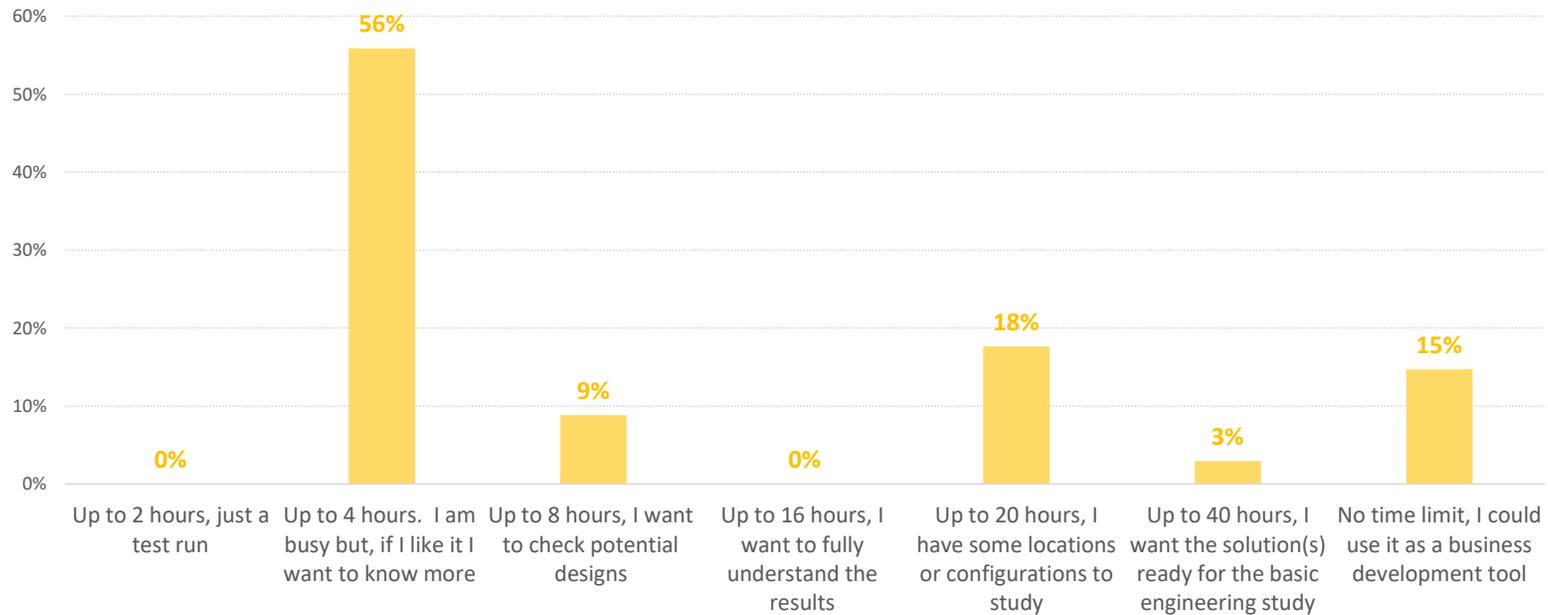
How much time would you be willing to spend testing the tool? Please mark as many scenarios that make sense for you

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# SURVEY RESULTS

- 56% of the respondents are interested on testing it while 44% are interested in using a tool like this.

How much time would you be willing to spend using the tool? Please check all the scenario(s) that make sense for you.



# Thank You!

Your feedback is appreciated!!

If you have any questions or are interested in collaborating with us on this tool, please let us know.

You can provide additional feedback via the full survey using the following link: [www.surveymonkey.com/r/L6FCSDY](https://www.surveymonkey.com/r/L6FCSDY)

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# Q&A

