

## Novel, Simplified Air Delivery System Design Gets Commercialized

Typical air delivery systems require contractors to create designs that are complex, difficult to integrate into the framing and structural components of a home, and often do not meet the optimization demands of newer energy-efficient homes. This complex process can be a burden to already strained construction labor costs. However, a new technology simplifies duct system design to improve comfort and eliminate sources of installation error for residential air delivery systems.

IBACOS, Inc., teamed with the Housing Innovation Alliance to create a plug-and-play (PnP) duct system that improves air distribution and comfort delivery issues in energy-efficient, production-built homes. A series of same-sized ducts end in rooms throughout the home and return to a central manifold, similar in fashion to a “home-run” cross-linked polyethylene plumbing system. The ducts needed for each room

### Project Information

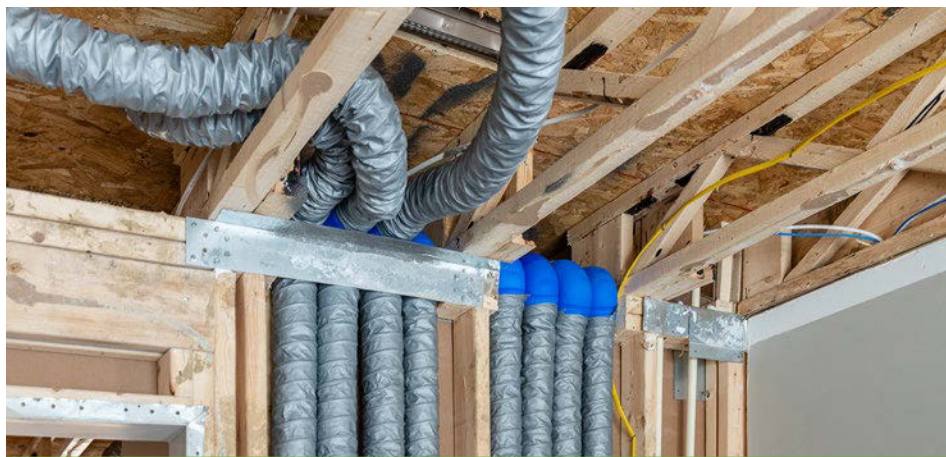
**Building Component:** Space-conditioning technology

**Team and Partners:** IBACOS, Inc., Housing Innovation Alliance

**Application:** Residential

**Year Tested:** 2015–2017

**Climate Zones:** All



Positive collaboration with the HVAC and home building industry has led to the development of Rheia™ technology, which will revolutionize HVAC practices while improving comfort and reducing energy consumption. *Photo from IBACOS, Inc.*

are simply attached to fittings located on the manifold, making it as easy as “plug and play.” With a well-designed manifold, each duct receives an equal static pressure potential for airflow from the air handling unit.

The smaller, flexible ducts allow for easy routing within conditioned space, resulting in significant energy savings where ducts would normally be routed in an attic or other unconditioned space.

### Innovative Design

The team completed various research, design, and development activities to determine the appropriate materials and duct diameters needed to adequately condition homes as well as the system’s advantages over traditional residential duct systems. These activities included lab testing and modeling, establishing a design methodology, and completing a time and motion study as well as a cost analysis.

Existing duct design methods are not appropriate for the PnP home-run approach, so the team established a design methodology specific to the system. Using this new methodology and calculation tool, a designer can:

- Select the correct number of needed ducts
- Calculate duct needs based on heating and cooling loads for each zone
- Estimate total length of ducts and elbows needed to reach each zone

- Adjust design airflows based on the type of duct material selected.

Cost is a key consideration for any new product introduced to the building market, so the team performed a time and motion study as well as a cost analysis to compare the labor and material costs of installing a PnP duct system with those of a traditional duct system.

### Key Research Findings

Lab testing and modeling led to key research findings and recommendations related to system sizing and configuration.

- Most homes up to 4,200 ft<sup>2</sup> in climate zones 3–5 could be adequately conditioned with 3-inch diameter ductwork



Rheia is a commercially viable product that integrates the PnP concept using 3-inch diameter flexible ducts. *Photo from RHEIA, LLC*



Installation of ducts and rigid, airtight fittings will allow for easy routing within a conditioned space. *Photo from IBACOS, Inc.*

- PnP systems require fewer components (SKUs)—as few as 5 unique components—compared to 18 or more different components needed for a traditional trunk-and-branch system
- PnP systems are easier to manufacture, stock, order, and process necessary components than traditional duct systems
- Door undercuts avoid the additional cost of return air within PnP systems
- Industry feedback on the PnP duct concept indicated genuine interest in the technology.

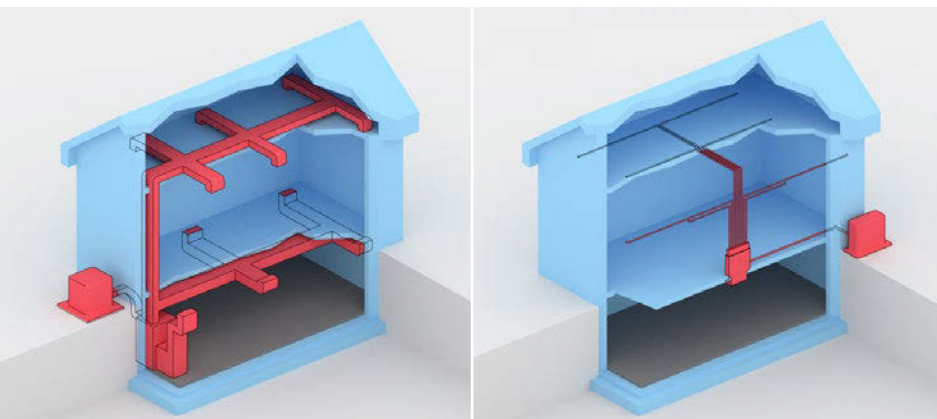
## Successful Market Engagement

The research team engaged with industry stakeholders to gain interest, acceptance,

and demand for the PnP. The team’s market engagement goals were to:

- Understand home builder attitudes and values
- Identify building code obstacles
- Understand consumer attitudes and values
- Secure builder commitment to demonstrate PnP technology and secure manufacturer commitment to commercialize the technology.

Positive collaboration with the HVAC and home building industry has led to the development of the concept into a commercially viable product: Rheia technology integrates the PnP concept using 3-inch diameter flexible ducts and patent pending, rigid, airtight fittings. The technology, coupled



Traditional air distribution system (left) versus a “plug-and-play” air distribution system (right). *Photos from IBACOS, Inc.*

## Learn More

### Technical Report:

[www.eere.energy.gov/buildings/publications/pdfs/building\\_america/osti-ibacos-plug-and-play.pdf](http://www.eere.energy.gov/buildings/publications/pdfs/building_america/osti-ibacos-plug-and-play.pdf)

### Guides:

- [https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/space\\_cond\\_lowload\\_pittsburgh.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/space_cond_lowload_pittsburgh.pdf)
- [https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/strategy\\_guide\\_compact\\_air\\_dist.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/strategy_guide_compact_air_dist.pdf)
- [https://www1.eere.energy.gov/buildings/publications/pdfs/building\\_america/duct-system-flammability-irc.pdf](https://www1.eere.energy.gov/buildings/publications/pdfs/building_america/duct-system-flammability-irc.pdf)

### Videos:

- <https://basc.pnnl.gov/videos/ducted-returns>

with unique predictive design software, stands to revolutionize HVAC practices while improving comfort and reducing energy consumption. Rheia is also compatible with existing standard furnace and air-conditioning equipment, making the process for adoption even more appealing. The technology is in the last phases of development and will be commercially available to select partners by mid-2020 with a broader roll-out to follow. ■

U.S. DEPARTMENT OF  
**ENERGY**

Office of  
**ENERGY EFFICIENCY &  
RENEWABLE ENERGY**



**IBACOS**  
| Innovation |

For more information, visit: [energy.gov/eere/buildings/building-america](http://energy.gov/eere/buildings/building-america)

DOE/GO-102020-5419 · August 2020