SCALABLE AND COST-EFFECTIVE ROLL-TO-ROLL ADDITIVE MANUFACTURING OF HIGHLY DURABLE SILICA AEROGEL BUILDING INSULATION
AN EXCEPTIONAL LOW-COST AND ECO-FRIENDLY SUPERINSULATION ALTERNATIVE FOR BUILDING ENERGY EFFICIENCY
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INTRODUCTION
Silica Aerogel Building Insulation: The major drawback for large-scale adoption of silica aerogels as a standard insulation material in buildings is their high production cost of supercritical drying and mechanical instability.

- Opportunities: The development of a cost-effective retrofit insulation that provides high R8/inch, primary energy saving of 0.265 Quads, CO₂ emission saving of 14 Mt.
- Low-cost and scalable manufacturing: high-throughput production (high-yield and continuous processes) at near standard temperature and pressure and avoid exotic or toxic chemicals ~$0.85/ft²-inch.
- Low-cost and robust installation: fast and easy installation, minimize occupant disturbance during the retrofit effort, and withstand common handling and installation practices.
- Durability: fire-retardant, structure, moisture, soundproof requirements.

Approach

A scalable cost-effective silica aerogel manufacturing

- **Low-cost Aerogel Insulation Material**: A low-cost silica aerogel insulation could reduce the unit price by 90% (project target: ~$240/kg, or ~$0.85/ft²-inch), meeting DOE’s cost target. According to the report by Allied market research in 2014, the interest in silica aerogel insulation is illustrated by the rapid growth in materials were sold, but this had increased to $500M by 2013 (expecting $1,927M by 2021).

- **R2R Manufacturing**: R2R manufacturing with ambient-pressure drying is the main contributor to the reduced production and installation cost of silica aerogel. R2R manufacturing can reduce energy costs by 50% and material costs by 90%. Because R2R manufacturing eliminates tooling, a product may be manufactured on the same day that the design is completed; lead time constraints are eliminated. An aerogel insulation material through near-net-shape manufacturing, meets health safety and durability (fire, structure, moisture and acoustic code) requirements.

**REFERENCES**