# Promoting Technology Transfer Of A Pumpless Solar Thermal Air Heater (Patent Number 10775058) Innovation Using The Customer Discovery Method In A Historically Black College And University (HBCU)

S. Addo* and P. Tyagi**

*Mechanical Engineering Department, School of Engineering and Applied Science, University of the District of Columbia, Washington, DC, 20008, USA, sampson.addo@udc.edu
** Mechanical Engineering Department, School of Engineering and Applied Science, University of the District of Columbia, Washington, DC, 20008, USA, ptyagi@udc.edu

## ABSTRACT

Prior research details the large gap that exists in the technological transfer of innovation between HBCUs and non-HBCUs. This is compounded by HBCUs being under-resourced and having a reduced focus on research and innovation. Several federal and private organizations are funding HBCU innovators aimed at transforming them into revenue-generating entrepreneurs. One of such federally funded programs, the NSF-CREST Center for Nanotechnology Research Excellence in the University of the District of Columbia is promoting innovation and intellectual property generation at HBCUs. Another federally funded program, NSF I-Corps focuses on training HBCUs innovators on the commercialization of innovations. The training aims at identifying key customer segments through interviews. This paper discusses how our innovation, the Pumpless Solar Thermal Air Heater functions and how we are promoting its commercialization using the NSF I-Corps customer discovery strategy.

***Keywords***: historically black colleges and universities, solar device, technology transfer, commercialization of innovations, customer discovery

## 1 INTRODUCTION

Historically Black Colleges and Universities (HBCUs) were primarily established to address unequal access to education and were primarily established as teaching institutions [1]. Though expressly established to educate people of African American descent, HBCUs have offered competitive higher education and training opportunities to students regardless of their race, background, and ethnicity. HBCUs are having a positive economic impact as detailed in a study commissioned by the United Negro College Fund (UNCF). According to the study (based on 2014 data), the total spending of 100 HBCUs was $10.3B; total economic impact on output (sales) was $14.8B; HBCUs employed 134,090 people, and graduated 50,037 graduates in the class of 2014 who can expect work-life earnings of $130B (that is 56 percent more than they are expected to earn without their 2014 certificates [2].

Notwithstanding these achievements, there is a large gap that exists in the technology transfer of innovation between HBCUs and non-HBCUs [3]. This is because HBCUs have been historically under-served as they were originally established mainly as teaching and blue-collar trade institutions [3]. To bridge this technology transfer gap, several federal and private institutions are funding HBCU innovators to transform them into revenue-generating entrepreneurs. One of such federally funded programs, the National Science Foundation (NSF) Center of Research Excellence in Science and Technology (CREST) Center for Nanotechnology Research Excellence (CNRE) in the University of the District of Columbia (UDC) promotes innovation and intellectual property generation at HBCUs. Another federally funded program, NSF I-Corps focuses on training innovators on the commercialization of mature or patented innovations at HBCUs. The training aims at primarily identifying key customer segments through a series of interviews. This paper discusses how our innovation, the Pumpless Solar Thermal Air Heater functions (with support from NSF-CREST CNRE), and how we are promoting its commercialization using the NSF I-Corps customer discovery strategy.

## 2 THE PUMPLESS SOLAR THERMAL AIR HEATER

The Pumpless Solar Thermal Air Heater (the innovation we seek to commercialize), is a portable, affordable, low maintenance, healthy, environmentally friendly, and sustainable way to heat rooms/spaces without using fossil fuel. This device (in figures 1 and 2) consists of

- a body housing a chamber surrounded by a heat-conducting medium;
- an intake pipe for drawing cool air into the chamber, and,
- one/more exit pipes with internal structures that create a low friction factor for the air flowing upwards while creating a high friction factor for the air moving downward, ensuring airflow in an upward direction as differential pressure is created between the entry point of

the intake pipe and the endpoint of one or more exit pipes.

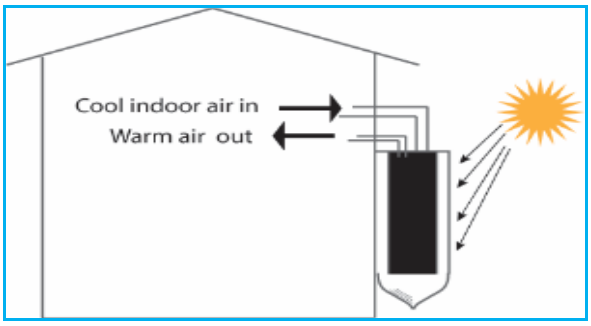


Figure 1: The pumpless solar thermal heater placed at the window of a house with sunlight

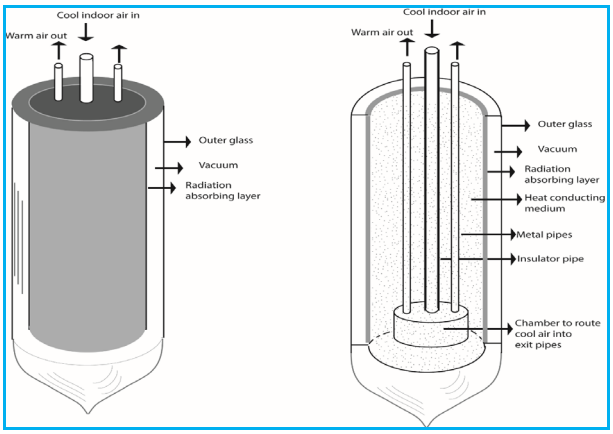


Figure 2: The heat exchanger showing the internal structures (intake pipe and exit pipes in the center)

This innovation uses a Heat Exchanger (HE) that creates net pressure to mobilize air heated by the sun radiation without utilizing any fan or mechanical pump. The HE is designed for a compact solar thermal air heater that is mounted in the exterior part of the home near a sun-facing window. It is designed to (a) draw indoor cool air inside the solar thermal collector, (b) heat the air by utilizing heat from the solar absorber, (c) push the heated air indoors. The manufacturing of the HE is better accomplished with the help of metal 3D printing.

## 3 RESULT AND DISCUSSION: THE CUSTOMER DISCOVERY PROCESS

The NSF I-Corps Introduction to Customer Discovery focuses on identifying key customer segments through a series of customer interviews, a fundamental step in the commercialization process of our innovation. Performed correctly, customer discovery is a customer-centric scientific process that puts evidence behind an assumed product-market fit [4].

The Introduction to Customer Discovery is a four-week course held online with 10 teams from different HBCUs during Spring 2021. During week 1, we discussed business models, customer segmentation, pains/gains, customer discovery action plan, evidence-based entrepreneurship, and hypothesis development. We conducted three interviews using developed questions based on our hypotheses. In week 2, we had an interaction session with one of the commercialization experts aimed at discussing our hypotheses and interview findings. We also presented our findings and lessons learned were noted for subsequent interviews. We were requested to interview additional 7 potential customers within the week. During week 3, we presented the results of our 7 customer discovery interviews. We conducted additional 10 customer discovery interviews. In week 4, we presented our findings from interviewing 10 customers in two groups to solicit comments from the commercialization experts. In all we conducted interviews for 30 customers, 20 were done during the 4-week course and 10 were conducted after the course. The interview process allowed us: to identify key challenges of potential end-users, validate some of our tested hypotheses, discover new health and environmentally related issues, and aided us to discover the market segment and early adopters of our innovation. We plan to conduct 20 additional interviews to target our identified market segment. Based on this experience, we plan to develop training modules to train engineering students in the University of the District of Columbia under the federally funded NSF-CREST CNRE project.

## 4 CONCLUSION

Based on the outcome of the interviews we concluded that our innovation has the potential to serve the needs of customers seeking; portable add on technology for their existing HVAC system to reduce their heating bills (87% of interviewees), ways to minimize health issues due to space heating (57% of interviewees), and low maintenance and >10 years lifetime heating system for mobile home or recreational vehicles (63% of interviewees)

## REFERENCES

[1] L. L. Esters and T. L. Strayhorn, Demystifying the Contributions of Public Land-Grant Historically Black Colleges and Universities: Voices of HBCU Presidents, Negro Educational Review, *64*(1-4), 119-134, 2013.

[2] J. Humphreys, HBCUs Make America Strong: The Positive Economic Impact of Historically Black Colleges and Universities. Washington, DC: UNCF Frederick D. Patterson Research Institute. 6-7, 2017

[3] C. Hamilton, "A Tool Kit for Building HBCU Technology Transfer Supply Chain Networks Using an Advanced Planning System," PhD Thesis. The University of Tennessee, iv, 2016.

[4] "What is Customer Discovery? A 4-Step Guide to Building the Right Product for the Right Customers, Future Founders, 2017.