

Commercialization History

As a leading developer and manufacturer of advanced remote environmental and meteorological instrumentation, Yankee Environmental Systems (YES) has literally built its product line by harvesting the SBIR program. Since 1996, annual commercial product sales have exceeded \$1M as a result of direct commercialization of SBIR awards. YES was founded in 1989 by a family of engineers and scientists and has been awarded multiple Phase I/II programs across seven agencies: Air Force, Army, Navy, Energy, Agriculture, National Science Foundation and National Oceanographic and Atmospheric Administration.

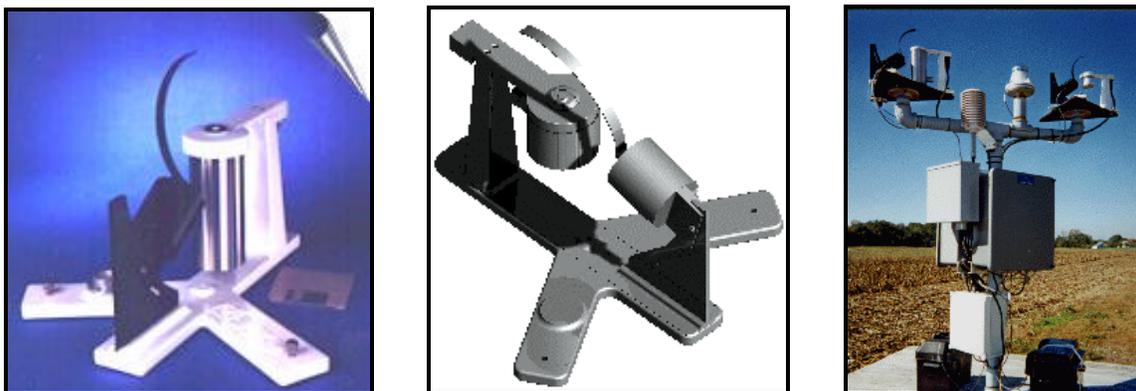
YES has quite a number of SBIR success stories to tell. These programs typically involved addressing a difficult environmental, nearly always “public” problem, where no private sector market mechanism existed to address a solution. Examples include ozone depletion, global warming/climate change, acid rain, renewable energy and aviation weather. As company policy, we only pursue contracts aimed towards new products complementing or extending our existing product line, *not for research alone*. YES has successfully commercialized EVERY completed SBIR program $\frac{3}{4}$ even in those programs where we won a Phase I but not a Phase II award! YES is often cited as an example to firms considering SBIR.

UV, Visible and IR Atmospheric Radiation (DOE, USDA, NSF)



Initial USDA Phase I resulting in Model UVB-1 (left, right); Phase II resulting in SPUV-10 (center)

For example, our very first SBIR program back in 1990 from USDA did not receive Phase II funding, partly because in our zeal to impress the sponsor we essentially completely solved the problem and had a product to market. Nevertheless, since that time, ***nearly \$1M worth of our Model UVB-1 pyranometers have been shipped, from an initial \$40K Phase I SBIR investment!*** A photograph of our UVB-1 instrument appears on the cover of the Department of Energy’s (DOE’s) SBIR Environmental Technology promotional folder.



UVMFR-7 (50 units, \$1M) – prototype solid drawing (left), completed unit (center), field units (right)

Nearly \$1M of the Model UVMFR-7 product has been delivered, and this is a direct result of a single 1995 \$200K USDA Phase II program. The advanced Model UVMFR-7 now forms the backbone of the 35 station US government UV monitoring network run by Colorado State University's Natural Resource Ecology Lab for the USDA. A typical site is shown above, center, and consists of a UVMFR-7, a UVB-1 and a MFR-7 radiometer. This national network makes continuous field measurements of UV-B radiation across the US and notifies the public of trends and status of stratospheric ozone, and data are reported the next day. For a look at USDA's live UV data on the web, see <http://uvb.nrel.colostate.edu>.



Model RSS-1024 (left) and TIR-570 (right)

At left, our Model RSS-1024 CCD Spectrograph and TIR-570 infrared radiometer both were born as DOE SBIR programs. In 1993 YES signed a technology transfer agreement with the Department of Energy (DOE) and the Atmospheric Sciences Research Center (ASRC) at the State University of New York at Albany. YES licensed an environmental instrument developed by these organizations called the Multi-Filter Rotating Shadowband Radiometer (MFR). Since that time we have developed several more advanced electro-

optical instruments for the DOE's Atmospheric Radiation Monitoring program (see <http://www.arm.gov>). The three commercial products resulting from two DOE Phase II SBIRs include our Model RSS-1024 visible/Near IR CCD spectrograph (\$100K sold), Model UVRSS-1024 UV CCD spectrograph (\$100K sold), and Model TIR-570 pyroelectric self-calibrating IR radiometer.



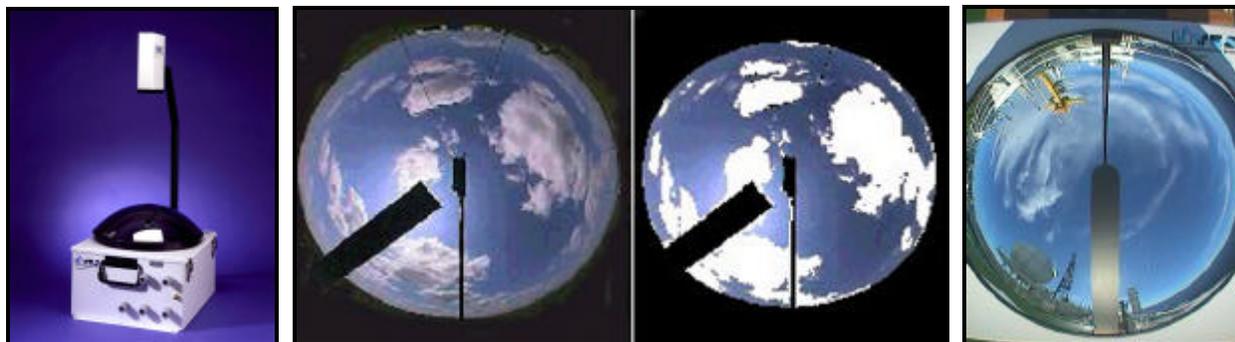
Model TSP-700 (left) and TIR-550 (right) radiometers

Another 1992 DOE Phase I program resulted in our Total Solar Pyranometer family, while a 1996 NSF Phase II program created our infrared radiometer, the Model TIR-550. These instruments are the typical workhorse for remote meteorological weather stations that require precise solar and atmospheric IR measurements. These instruments also required the development of sophisticated optical calibration facilities. Another example of a Phase I program that, despite not receiving a Phase II award, still produced a product was our 1996 USDA program to develop a portable optical calibration system. NASA then became interested in this technology when its Sea-viewing Wide Field-of-view Sensor (SeaWiFS) ocean color satellite required ground truth/calibration aboard ships at sea. The Model OCS-5002 was the result (shown at left). The system provides a highly stable light source for calibrating filter-radiometers aboard ship. A 1993 NSF Phase I produced the Model UVA-1 pyranometer.



Model OCS-5002 Optical Calibration Source

All-Sky Imaging Systems (USDA)



Total Sky Imager Model TSI-880 used by Navy and FAA (left), input and processed cloud decision image (center) and shipboard variant test aboard the USS Ron Brown (right).

A wide variety of meteorological and physical security applications require remote observations. A 1996 USDA Phase II program produced the YES Models TSI-440 and TSI-880 Total Sky Imagers (TSI). These systems feature internet-enabled TCP/IP communications and feed live JPEG imagery to remote users via web browsers, or to digital storage media that is then databased for later retrieval and analysis. Proprietary image processing algorithms are run on an on-board processor to extract value-added products such as cloud cover, haze and sunshine duration. This product is our most successful and continues to grow as new applications are found. *In 2001, the company was awarded the “SBIR of the Year” award for the TSI by the Massachusetts Technology Collaborative, a quasi-public, state-funded agency.* Winning this is especially noteworthy because of the intense competition; Massachusetts enjoys the second highest number of SBIR awards per year (behind California), and actually leads the nation in dollars per-capita.

Temperature and Humidity (Air Force, USDA)



MET-2010, now the core of TMS WX station

The Model MET-2010 Meteorological Thermo-hygrometer is the most precise instrument in the world for making outdoor measurements of ambient and dew point temperature. A spin-off of a 1995 Air Force Phase II program to make precise upper air humidity measurements to support the calibration of Defense Meteorological Satellite Program (DMSP) humidity retrievals, the MET-2010 has now evolved to a line of industrial chilled mirror dew point hygrometers. Part of this evolution involves a 2001 Army SBIR Phase I program that required a distributed network of surface weather systems.

The MET-2010 was adapted by adding a suite of additional “best of breed” met sensors including a 2-D sonic anemometer. These systems are now being marketed as the Total Met System (TMS). On September 11th a TMS system running remotely at the Army’s Ft. Benning MOUT facility was demonstrated live to Army Research Laboratory scientists at the White Sands Missile Range in NM. It is important to recognize that the TMS system was delivered along with a TSI-880 sky imager to untrained Army personnel who set it up without incident at Ft. Benning in less than an hour. The TMS is yet another example of YES using a Phase I to launch a product.

Today and Tomorrow - Software

YES has grown from its initial roots in instrumentation for total column aerosols, atmospheric radiation, stratospheric ozone and global warming. The company is expanding into new environmental areas with several active SBIR programs for both *in-situ* and remote upper air measurements, remote sensing Doppler LIDAR, acid rain precipitation collectors, and even wind energy for the DOE’s National Renewable Energy Laboratory. This diversification and growth has been accommodated in part by our

close proximity to the University of Massachusetts at Amherst (considered to be a “top 20” engineering school). In addition, our technology transfer agreement with SUNY/Albany and Virginia Tech leverages ideas gleaned from not-for-profit labs. The company tries to practice the “virtual company” concept by focusing on the research and design, sales, service, calibration, technical support and final assembly. Machining, painting, and printed circuit board (PCB) assembly are left to other vendors.

Many of the programs discussed involved the development of extremely sophisticated firmware and user software. In 2002, the company announced an internal initiative to establish a self-supporting software division to elevate this critical function to the status it deserves. As the complexity of systems and instrumentation has increased, so has the need to support continuing engineering of software products beyond what hardware-centric product development programs could provide. Several SBIR opportunities were then identified as potential avenues for funding this initiative. In particular, distributed peer-to-peer object repository to share instrument data and image-to-image comparison and subtraction algorithms.

YES currently employs roughly 30 people including consultants; 15 of whom are degreed technologists involved with R&D of new high tech products. The firm builds and sells its products via a worldwide network of domestic and international sales representatives. Located in the poorest county in the state, YES is a standout in a rural area suffering economic hard times due to the flight of traditional "old-economy" manufacturing plants that have historically focused on paper and machine tools. The location at an airport further facilitates the research and development of visibility sensors that may enhance air traffic safety in the future. Integrated together, the individual sensors developed from these SBIR programs form a powerful surface observation system that fully characterizes the atmosphere above a site.

Finally, as most YES products are designed to harness advanced web / Internet networking technologies they permit live data connection to remote users. For example, our Total Sky Imagers are quite visual and even fun to watch. Several of our instruments (TSI systems and RSS systems) are running live on the web. Reviewers are urged to look at these systems in action, by visiting <http://www.yesinc.com> and click on the demo section. Detailed data sheets on all of the SBIR-driven products are also available.

