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# Bringing Hydraulic Hybrid Retrofits to Developing Nations (Colorado State University)

**In this week's Green Inventors Series: Colorado State University students get more than an education, they learn an eco-friendly lifestyle.**



By [Eric Leech](#)

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**Colorado State University Hydraulic Hybrid Retrofit Team - *Colorado State University***



**Typical inefficient city bus found in India** - *Colorado State University*



**Close-up of the driveline used for the parallel hydraulic hybrid** - *Colorado State University*



**The CSU hydraulic hybrid in action!** - *Colorado State University*

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The National Collegiate Inventors and Innovators Alliance combined with the support of the Lemelson Foundation provides \$1.5 million to student and faculty programs and ventures annually. These programs are put to great use as they allow today's youth to participate in some of the kinds of thinking that will eventually change the world...one small invention at a time.

Today, we are going to look at a project that is being led by some of the engineering and business students at Colorado State University. More specifically, the Department of Mechanical Engineering [Engines and Energy Conversion Laboratory](#) and the College of Business graduate program [Global Social and Sustainable Enterprise](#).

These students have taken on the rather large task of designing hybrid retrofit kits that can be used with a variety of stop and go vehicles, such as public transport buses, that will not only be affordable and effective for developing nations, but also simple to install and operate. You have to keep in mind that developing nations do not have the available funds to purchase all new and efficient utility and public transportation vehicles, so they must come up with cost effective means of pollution reduction, which is not always marketable or profitable unfortunately.

This is where the business school comes into play, as they are working with the engineering firm, [C Zero Solutions](#), to evaluate the possibilities of manufacturing and exporting these retrofit kits across the oceans to where they are needed most. Out of the 800,000 world deaths per year caused by air pollution, it is the developing countries in Asia that account for nearly 550,000 of these. With so many lives at stake, Colorado State University and C Zero are proud to be a part of this important project.

To find out more about this project we spoke with Mac McGoldrick, Programs Manager and Research Anthropologist of the Engines & Energy Conversion Laboratory at CSU, Rick Turley of the College of Business at CSU, and Guy Babbit of C Zero Solutions:

**Tell us a bit about your hydraulic hybrid retrofit project?**

Guy: "[Hydraulic hybrids](#) are another way of hybridizing a vehicle much like [electric hybrids](#). Hydraulics hybrids have a nice features. One such feature is their efficiency for stop and start vehicles. They can recover and utilize more energy than you could out of a typical electric hybrid. That is the nature of hydraulics, which makes them really well suited for stop and start buses, trash trucks, and other vehicles such as this. Hydraulics are also less expensive to build and maintain."

"People have been looking at these for a long time, dating back to the 50s and 60s, but gasoline and diesel has just been too cheap for too long. Some of your major manufacturers today are very close to production of these. They were actually supposed to have gone in production a little less than a year ago, but they are having some hiccups on the way up. They should be in full production in about a year. These manufacturers are looking almost exclusively at new vehicles and not retrofits, so they are going to focus their attention on well developed markets, such as the U.S. and Europe."

"For our project, we are looking at the possibility of taking these products over to developing nations. The thought process behind this is by taking these over to such areas you can get some

fairly substantial fuel economy gains, while also netting a reduction in world emissions. This could become an economic incentive for such developing nations to reduce pollution in their crowded cities."

**How have the students been involved specifically with the project?**

Rick: "The student involvement is focused on two counts. First from an engineering perspective, the engineering students are able to participate through applying their classroom knowledge of hydraulic hybrids into working with an actual retrofit truck. The other program involved is the Global, Social, and Sustainable Enterprise Program, which is a Masters level program here at the business college, which trains student to build businesses at the base of the pyramid. I traveled with two students who spent the summer in India doing studies and evaluations of the appropriate technologies that would be necessary to build a business there."

**What is it about your design that makes it unique?**

Guy: "We were building heavily off of technology that has been around for awhile, so our thoughts were that we could make an even simpler solution. Rather being fully electronically integrated to the engine, we could create a lower cost solution that may be mechanical and might have driver involvement. This provides a couple of things. One, this single design could go into a lot more vehicles. Two, it would be designed to pull quite a bit of cost out of the final product. Much of the cost of a hydraulic hybrid is in the electronic control and the time to write that software and calibrate it. We are proposing a solution that maybe isn't quite as elegant as these, but at the end of the day it will produce the same results. Also, our retrofits are built with parts off the shelf, rather than using custom parts."

Rick: "You have to remember we are speaking of areas where labor is relatively cheap and people are willing to put up with less automation. They are not concerned with productivity, they are more concerned with reliable, easy to use solutions, so a C Zero hybrid retrofit bus that might require some manual intervention on the part of the operator to get the best performance will not be an issue for such areas."

**What is the design of the prototype you are working on right now?**

Guy: "The prototype is an International 4700 truck, which is basically the type of vehicle you would get at a U-haul or Penske that has a 24 foot box on it. It is about as big as a truck as you can get before you are classified as a Semi."

**Could you give us some numbers on the actual savings that these hydraulic hybrids provide?**

Guy: "Sure, a simple system such as we are proposing, which is called a [parallel system hybrid](#), can achieve fuel economy gains of 20 to 30 percent on the cycles they are running, such as the daily cycle of a bus transport. This is very significant when you consider the amount of fuel that these vehicles burn."

"We can take our vehicle up to say, 30 mph, then shut the engine off and bring the vehicle to a stop using the hydraulics, then get that vehicle back up to 15 or 20 mph before we even need to start the engine back up. We haven't quantified the fuel savings for our particular vehicle yet, but that should give you an idea of the amount of fuel savings we are talking about."

**What is your next step?**

Guy: "To take this project to the next level, we need to see if it makes sense to put these into production and we are still evaluating the market we chose, which was India. We are looking at the technology and making significant improvement. We are also currently doing a second generation hydraulic hybrid using the remainder of our funding from the NCIIA and other sources (city of Fort Collins). We are going to continue to look for more additional funding and come up with a more robust and applicable solution."

Sounds great to us Guy, Rick, and Mac. We here at Planet Green thank you for your time and expertise. We will keep our eye out for the hydraulic hybrid retrofit to hit the streets of India in the hopefully near future.