ENERGY // ENVIRONMENT

FEATURE

Deflating the Air Car

Green cars could run on compressed air instead of batteries. But don't rely on the new AirPod minicars to prove it

Photo: Vincent Lignier

BY PETER FAIRLEY // NOVEMBER 2009

A new celebrity with a lusciously curved body is turning heads on France's Côte d'Azur. No, not that kind of body. This one belongs to the AirPod, a 220-kilogram car with a sculpted composite shell and a back-to-the-future energy supply: 80 kg of air compressed to 350 times sea-level atmospheric pressure, roughly 350 bars. The engine of this tiny three-seater converts that air into mechanical energy, just as a pneumatic jackhammer does to blast apart concrete.

The AirPod won't exactly tear up the road, though: The current version tops out at 45 kilometers per hour (28 miles per hour). And yet there's definitely something addictive in its joystick steering and featherlike suspension. With expanding air pumping its pistons, the exhaust is literally a superchilled breeze. Grab the stick, step on the accelerator, and any guilt you may be harboring from driving an ordinary smog-producing carbon spewer falls away. Wouldn't life be great if everybody got around town in these clean little machines?

This rosy vision of future urban transport is the product of Motor Development International (MDI), a company registered in Luxembourg whose tech-chic atelier lies in Carros, a palmy industrial suburb of Nice, France. Guy and Cyril Nègre [above], the father-and-son team behind MDI, predict their technology will find mass appeal in the emerging city-car category, an automotive segment of small, efficient cars well suited for crowded European and Asian cities and not meant for long-haul trips.

Most carmakers think that battery power is the future for this category, but the Nègres beg to differ. The AirPod, they promise, can tank up in just 2 or 3 minutes using no more than 1.5 euros' worth of France's nuclear-heavy, low-CO_2 electricity to provide some 220 km (137 miles) of city driving. It has no batteries to wear out and replace—and so will cause no worries about its power source ever erupting in flames. And the AirPod will cost a mere €6000, the Nègres say (less than US $9000).

Storing energy in a long-lasting pressure tank made of carbon fiber rather than in batteries, posit the Nègres, makes the AirPod cheaper, more practical, and cleaner than a comparable electric vehicle (EV), once you take manufacturing and disposal into account. It's a bold assertion, and one that remains to be proved, which won't be possible until these cute little cars actually hit the road. And when that will happen is anyone's guess.

Though the AirPod is supposed to go on sale in a couple of months, the Nègres have been struggling to commercialize pneumatic vehicles for more than a decade, incurring a reputation for unfulfilled promises. No independent testing laboratory has assessed the AirPod's performance. And while deals over the past three years with India's Tata Motors and Paris-based Air France have bolstered MDI's credibility, it remains tough to find an automotive engineer who buys into the company's vision. The fundamental problem, they say, is the laws of thermodynamics, which make compressed air an impractical power source for vehicles. The AirPod's 200-liter tank is roughly the size of a common 55-gallon drum, but it carries the energy of little more than a liter of gasoline. And its air-powered engine makes inefficient use of it. MDI counters that the ultralight, low-speed AirPod needs very little to get around. Yet skeptics abound.

"I don't know how they can deliver what they claim," says Denis Clodic, a mechanical engineer and thermodynamics expert at France's prestigious École des Mines de Paris. "It's not a solution for the sort of vehicle we expect today," says Pascal Higelin, professor and director of the Mechanics and Energy Laboratory at the University of Orléans, in France.

And yet Higelin and Clodic count themselves among the growing number of propulsion authorities who say that vehicles combining compressed air and fuel combustion could overcome the primary drawbacks of both, providing an economical alternative to today's gasoline-electric hybrids. The greatest impediment to realizing such pneumatic hybrids, according to these two experts, is that the failure of MDI's air car could cast doubt on the whole idea.

So if the AirPod does whoosh onto French streets within months as promised, there will be quite a bit more riding on the quirky little runabout than MDI's fate. It could finally prove the viability of compressed-air transport—or doom it for the foreseeable future.

Pod Squad: Workers at Motor Development International are busy readying AirPod prototypes at the company's fabrication facility near Nice, France. Viewed from underneath its curvaceous shell [upper left], the AirPod reveals an aluminum frame, which encloses a composite tank holding air compressed to 350 bars [lower left]. A steering wheel would be impractical, because the driver's door is located at the

Pneumatic propulsion was high tech in the late 19th century, when compressed-air engines and equipment became commonplace in Europe and North America. Networks of compressed-air piping vied with

then-nascent electrical grids to power machine tools, railway hoists, and switchyards, among other heavy gear. Meanwhile, the first jackhammers were revolutionizing mining and tunnel construction. Propulsion uses included pneumatic torpedoes, locomotives, and streetcars. Addison C. Rand, founder of Rand Drill Co., lauded pneumatic streetcars in his 1894 guide *The Uses of Compressed Air,* noting that they had neither the "distressing, jerky motion" of cable cars nor the capital costs of electric railways.

Combustion-powered automobiles and buses ultimately prevailed, as we all know. But a vestige of air propulsion survives in today's Formula 1 racing pits, where blasts of air crank the big engines to life, and it is from this world that Guy Nègre emerged. The self-taught mechanic studied philosophy and worked in French carmaker Renault's advertising department in the 1960s before setting up his first engine-design shop. There Nègre developed an unusual valveless engine for light aircraft, a design that was never commercialized. Nègre's second shop extended the valveless concept to powerful Formula 1 race-car engines. In 1990, a racing club installed Nègre's engine for the storied Le Mans 24-hour endurance race. But the engine refused to start, let alone endure for 24 hours. This firm, like the one before it, slid into obscurity.

In 1991, Nègre made the intellectual 360 that led to the AirPod. Together with his son Cyril, then an engineer for Bugatti Automobiles, Nègre formed MDI to develop low-emissions engines, and by 1996 they had locked onto air propulsion. While both father and son's names are listed on the firm's patent filings, Cyril is officially the R&D director, and Guy is the president, responsible for selling their vision.

The "thermo" of thermodynamics—the unstoppable flow of heat—makes pneumatic propulsion a considerable engineering challenge. The molecules of oxygen, nitrogen, and other gases in air give off heat when compressed, representing a loss of energy up front. Do the compression quickly, before the heat can dissipate into the surroundings, and the losses rise further. And the trouble only mounts when all this compressed gas is later released from the tank. The same molecules cool when they expand, hence the chill on your hand when you empty a spray can. Expand the gas slowly, and the pneumatic equipment can stay warm by reabsorbing energy from the atmosphere. But power-hungry vehicles must expand the gas quickly, so they are subject to extreme cooling, which hampers the engine or, at worst, freezes its air-feed lines.

By the late 1990s, MDI was talking up a first-generation engine it claimed could handle these complications. Its design would expand air in three stages, maximizing the opportunity to absorb heat, just as efficient multistage gas compressors maximize heat dissipation. The firm used this design to raise money, selling franchises for the local production and sale of its vehicles and raising expectations. For example, the sale of the first such franchise—rights to the Mexican market—sparked press reports that smog-choked Mexico City would soon mandate MDI's "zero-pollution" technology for its 87 000-strong taxi fleet.

Photos: Vincent Lignier

Tricycle Gear: Behind the driver are seats for two passengers [top left]. Tanking up [top right] takes just a few minutes. Below, a test car hits the streets.

By 2000, production was slated for 2002. In 2002, it was to begin in 2003. Indeed, commercialization was always just around the bend. But the promised vehicles never arrived. Icing of moisture in the air-feed lines, the pneumatic equivalent of plaque-choked blood vessels, sapped efficiency and output. And the system was impractical to mass-produce. “We could reach good efficiency with that [design]. We had ideas for how to do it. But it was complex,” admits Guy.

From 2003 to 2007, MDI was dead in the water. Debts mounted while the staff contracted, from a high of 50 employees down to 12. What saved the firm was a simpler engine conceived in 2005 and now being readied for the AirPod. In January 2007, Tata Motors purchased the Indian rights to MDI’s technology for an undisclosed sum, widely reported as $30 million, repairing both the firm’s finances and its tarnished reputation. “It was clearly the patents, the designs for the new-generation [motor] that convinced Tata to link up with us,” says Guy.

MDI’s second-generation design drops two of the three stages of expansion and is thus simpler and more robust, the Nègres argue. The key to efficiency, they say, is its pair of specialized, interconnected cylinders [see diagram below]. Air released from the tank is allowed to expand to 20 bars before being fed at constant pressure to the first cylinder, which MDI calls the active chamber. When the active chamber’s piston reaches full extension, a valve attached to the air inlet closes. Only at this point is the air allowed to expand, pushing its way into the second, larger cylinder. Because the pressure in the active chamber is constant when the air valve is open, the valve and air-feed lines don’t overchill. Only as the larger cylinder’s piston moves does the air expand enough to reduce the temperature past the freezing point—well past it: During the exhaust stroke, the frigid air is expelled to the muffler at –40 to –70 C. “Once the valve is closed, you can cool [the air] a lot, because if there is ice it will go to the exhaust,” says Cyril.

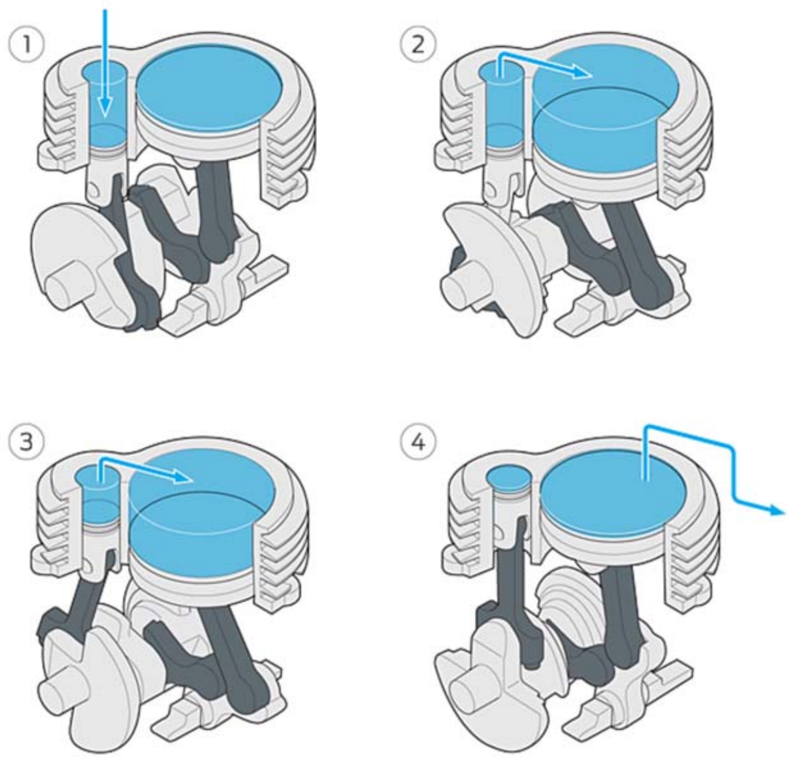

Illustration: Jason Lee

Double Duty: The AirPod’s engine uses two linked cylinders. Compressed air flows into the smaller cylinder first at a constant pressure of 20 bars [1]. When the smaller piston bottoms out, the intake is closed, and the air in the small cylinder expands, flowing into the larger cylinder [2 and 3]. Both pistons then move to exhaust the expanded air [4], and the cycle begins again. *Click on image for a larger view.*

See related video here.

By the end of 2007, Guy was once again promising imminent commercialization, gearing up for production of a city-car sedan. But MDI shifted course in January 2008, when the mayor of Paris announced plans to station thousands of rent-by-the-hour city cars around town. The competition to provide such ecofriendly personal transportation would be fierce, but the rewards to the winner could be great. So Guy dreamed up the AirPod as a pneumatic entry in that contest. Anticipating a quick road-certification process, because this featherweight minicar doesn’t exceed the 500-kg threshold for requiring crash testing in the European Union, MDI decided to throw its resources at the AirPod.

“That’s what MDI needs: to get a car on the market,” says Cyril.

The AirPod made quite a splash when it was unveiled in October 2008. It was then that the mayor of Nice, who also leads the local regional authorities (and, in a peculiarity of French democracy, serves in President Nicolas Sarkozy’s government as well), committed the city and region to testing compressed-air vehicles and, perhaps, to using them in a Niçoise version of the Parisian car-rental scheme. A week later, Air France and affiliate KLM signed up to test half a dozen AirPods in their maintenance hangars.

Guy insists that within the first few months of 2010 MDI will have its first assembly line at Carros churning out one AirPod per hour while he and his son are coordinating the creation of three more assembly plants set up by European licensees.

Could the AirPod be the vehicle that finally makes good on pneumatic propulsion? Analysis of performance specs that MDI supplied to *IEEE Spectrum*—among the first released by the firm—suggest that the vehicle's range may be less than a third of the 220 km (137 miles) claimed. But with gasoline prices expected to rise along with global temperatures, even that modest distance may be sufficient to interest buyers.

According to MDI's figures, the 80 kg of compressed air in the AirPod's tank has the potential to generate 11.2 kilowatt-hours of mechanical energy when fully expanded at constant temperature—a truly best-case scenario. The engine's minimum operating pressure of 10 bars will leave a few kilograms of air in the tank, trimming total usable energy to 10.8 kWh. The process of expanding the air before it is sent to the engine, however, gives this figure a lot more than a trim: Dropping the pressure from 350 bars to 20 bars before the air can be fed to the cylinders wastes nearly half the stored energy. So that leaves just 5.6 kWh to spin the AirPod's wheels. MDI vows that the production version of its engine will somehow do better, providing 6.2 kWh of mechanical energy where the rubber meets the road. "We know what to do," Guy says. But the firm's best effort to date passed just 4.4 kWh to the wheels, he concedes. Because the AirPod requires 2.8 kWh to travel 100 km on a standard European urban driving cycle, the numbers indicate that its range can be only about 160 km.

But even that figure sounds unrealistically high to outside experts. Clodic of the École des Mines, for example, estimates that the engine's limited efficiency will provide only 1.9 kWh of usable mechanical energy for a maximum range of 68 km (42 miles).

The efficiency stats look even worse when you include the energy cost of filling the AirPod's tank. MDI says its plant's compressor is 58 percent efficient, near the top end for commercial units. Using MDI's numbers, this means that the AirPod's plug-to-wheels efficiency is currently just 23 percent. That makes an unflattering comparison with the lithium-battery-powered EVs approaching the market, such as Mitsubishi's iMiEV subcompact car, which is expected to operate at three times that efficiency.

The Nègres argue that although lithium-ion-powered EVs can beat the AirPod's efficiency by a large measure, they make for unrealistically expensive cars. A lithium battery for the AirPod would cost almost as much as MDI will be asking for the entire vehicle. Most city cars on the market today use cheaper but heavier and less efficient lead-acid batteries. As a result, estimates MDI, those EVs actually suck more energy from the grid for each kilometer traveled than does the AirPod. Doug Nelson, an expert in hybrid vehicles at Virginia Tech, in Blacksburg, can't confirm that assessment, but he agrees that pneumatic vehicles could be a winner for the city-car segment if lithium batteries remain too pricey.

The promise of a cheaper form of clean transport is indeed what convinced Air France to consider AirPods, according to Jérôme Bouteyre, the airline's director of facilities management. EVs that Air France has tested as runabouts for its maintenance crews cost between 15 000 and 35 000—a steep jump up in price from vehicles of similar size with internal combustion engines, which can be had for less than 10 000. So the AirPod is economically competitive with conventional vehicles of this sort, and critically, it meets Air France's modest needs—according to Bouteyre, a top speed of 30 to 40 km/h and a range of 10 to 20 km per day.

Motorists, however, have come to expect much more from their cars. That's why some of MDI's critics think that automakers should be focusing not on air-powered cars but on pneumatic-fuel hybrids. Unlike cars running on compressed air alone, the greater power available from pneumatic hybrids would suit full-function, highway-capable vehicles. And compared with today's hybrids, whose battery-equipped drivetrains cost three times as much as an ordinary gasoline engine, pneumatic hybrids could be priced for economy shoppers and for the developing world. ”We have a system that provides 80 percent of the benefit and costs maybe 20 percent extra,” says Lino Guzzella, a professor of mechanical and process engineering at the Swiss Federal Institute of Technology, in Zurich.

With support from German auto-components giant Robert Bosch, Guzzella is testing small engines that use a 20- to 30-L compressed-air tank to rival the performance of power plants twice their size. That tank is filled with air pressurized to 20 bars using braking energy or spare engine power. In this novel variation on conventional turbocharging, that high-pressure air is then fed back into the engine along with extra fuel to deliver precise bursts of power. ”We are able to burn the fuel in a much more efficient way,” says Guzzella [see sidebar, ”Turbocharging the Turbocharger”].

MDI is working on an even simpler hybridization scheme, first successfully employed in 1901 to extend the range of pneumatic torpedoes. The idea is to add a small fuel burner upstream of the engine to warm the air released from the tank, increasing the air’s volume and thus reducing the amount required to charge the cylinders. MDI claims this dual-mode system will triple the AirPod’s range, while consuming just 0.56 L/100 km of gasoline (420 mpg). Clodic, however, questions whether MDI possesses the discipline and resources to see this hybrid system through.

MDI’s prospective industrial partners, Tata Motors and Air France, seem to have a wait-and-see attitude. Air France, which originally expected to begin testing AirPods in May and was still awaiting delivery as this article went to press, isn’t worried, according to Bouteyre: ”Either it’s built and corresponds to our requirements, or it’s not and we won’t try it. We have nothing to lose.” The head of corporate communications for Tata Motors, Debasis Ray, says his company is licensed to use MDI’s technology in India, ”only as and when it gets ready. We are not engaging beyond this at this point in time.”

Guy’s response to the skeptics? He says that there is no such thing as a truly independent expert for assessing novel vehicles: ”The only evaluation possible is on the road.” True enough, but that’s only an option if others can acquire examples of the finished product. And in all the time that MDI has been working on vehicles, no product has emerged. In the computer industry that’s known as vaporware, an appellation that seems oddly appropriate for a car that runs on air.

This article originally appeared in print as "Driving On Air."

About the Author
Vincent Lignier photographed the green-car contender AirPod in Nice, France, for "Driving on Air" [p. 30]. His biggest challenge in capturing the futuristic pod was trying to even out the car's reflection while shooting. "It's like an egg," he says. "If there's no reflection in one part, it's reflecting somewhere else." Lignier's work has been featured in such publications as Rolling Stone, Vibe, Forbes, and France's Libération.

To Probe Further
To see an online slide show surveying other micro-size cars, go to http://spectrum.ieee.org/micro_cars.

most recent comments

Jim Bullis, Miastrada Company 11.11.2009
Thanks for the insightful article. Also, thanks for the PV article of last spring which you linked to here.--Now how about getting an text editor that lets us write with paragraphs.
---It is difficult saying serious things in a twitter like format..

BRUCE CARSTEN 11.11.2009
The "air car" sounds like a niche solution at best. Capital costs may be low, but the very low efficiency of energy storage and recovery is a show stopper for widespread application. Adiabatic compression and expansion would theoretically be much better, but since it would be hard to keep the compressed air from cooling off, it seems to me that isothermal compression and expansion is the best practical, and by dropping the pressure significantly before entering the motor the situation is even worse. Taking the "low capital cost" model to a new level, perhaps a wind-up,spring powered car should be considered..

ANDREW 11.09.2009
If the exhaust is really at -70C, it would be interesting to see weather some electrical energy could be reclaimed using a Stirling generator such as those manufactured by SunPower inc in Athens Ohio, or MicroGen England. A beneficial side effect of attaching such a generator would be that it would heat naturally the exhaust as a side effect of producing electricity from the temperature difference itself. I have personally worked with some of stirling electric generators for military applications and from my experience is seems possible to run a cylinder similar to ones they produce using the 90C difference between the exhaust and the ambient air. Probably half of the "Wasted" energy could be reclaimed as electrical energy, to make an Air-Electric Hybrid and potentially extend the range, or at the very least run all of the electronics in the vehicle. And as for efficient "Green" compressors, the ones produced by Danfoss Turbocor in Tallahassee Florida would be almost ideal for running an "Air Gas-Station"..

DAVID HAYNES 11.06.2009
Let's not write off compressed air energy storage as a means of storing energy. There are a couple of facilities in the world that use compressed air for utility-scale bulk-storage of electrical energy. Their are other designs on the drawing board as well, and the efficiencies appear to be as good as pumped hydro. While this is great news to address the growing need for energy storage to stabilize the grid, the challenge of using such a technology for transportation purposes remains a considerable challenge. As Mr. Negre and the author point out, battery powered vehicles tend to be costly. We also know that today's fuel cell designs are costly. I would like to suggest that ongoing research is needed into energy storage technologies. We can't give up on batteries, hydrogen, fuel cells, or even air power in our efforts to develop viable technologies that will sustain our way of life into the future. .

CHARLIE 11.05.2009
Marsupy, I have read and understand US Patent 7,296,405 by Cyril and Guy Negre. It appears to be the US patent filing associated with the link you provided. You should read it. While the patent is an ingeneous and novel way of controlling the speed of an air engine, there is indeed a 50% loss of energy in going from tank pressure (item 30) to the buffer tank (item 31 in the patent). Note that the air does NOT do any mechanical work as the pressure is reduced at the input to the buffer tank, and therefore that energy is lost..

MANFRED HOFFMANN 11.05.2009
How would this technology work for Golf Carts? There must be a multi-million Golf Cart market around the world. It seems like the perfect solution --- short distances to drive per day --- light weight (no batteries to charge) etc. M.Hoffmann.

MARSUPY 11.05.2009
Hello ! (3rd and last for today ;o)) About range and Shiva's "20 miles" assertion... From: http://www.msnbc.msn.com/id/30930300/ "...Vencat expects it to go about 20 miles on compressed air alone..." This actually means nothing ! What did exactly say Shiva ? What air car model was he talking about (AIR-Pod, One, Mini, City) ? Each vehicle has very different specifications (mass, front surface, drag coef.) that do act on range ! Range of 20 miles at what constant speed or in what driving cycle (city, highway, mixed...) ? Journalists shouln't write papers about technology without minimum scientific knowledges ! :o(So, Shiva said 20 miles (32km) of range ? Yes, it can be true for the CityFlowAir model on highway, by example ! Ok guys ! Let's go "inside technology" & maths & physics ! :o) With these parameters: Mass of vehicle 800kg+driver 70 kg+half empty tank 80kg : 950kg Tyres rolling resistance coef.:0.010 Front surface: 2.2m^2 Drag coef.: 0.35 Constant speed : 130km/h (about 80mph) Tanks: 400

liters@330bars(useful pressure) => 18.5kWh (max.theorical energy with isothermal expansion using Van Der Waals model that is less "optimistic" than real gas law calculation but more accurate with air at 330 bars) Motor efficiency:35% (18% less than 43% claimed by MDI on bench) Drive train efficiency: 95% using these well known formulas: -- * Power needed to overcome rolling resistance * -- P roul. = f x g x m x V with : ^x = to the power x f rolling resistance coef. = 0.010 for asphalt (recent tyres) g acceleration due to gravity = 9,81 m/s^2 m mass of the vehicle in kg V speed of the vehicle in m/s --- * Power needed to overcome air resistance if no wind * --- P res.air = rho x Cx x S x V^3 with : rho air density = 1.202 kg/m^3 Cx : Cd of the vehicle S frontal area of the vehicle in m^2 V speed of the vehicle in m/s == Total power needed to run at V constant speed = P rol. + P air res. == ==> you get a maximum range of 20 miles ! BUT, MDI's car are not intended to run on air on highways but IN TOWN where it's more and more important to reduce the pollution ! In urban cycle, the previous parameters give a range of 97km (60miles) that is rather good ! To leave cities, as say Shiva, an external burner will be used to extend the range, with very low pollution (full combustion, temperature<900°C). So, running on pure compressed air in town will be soon an interesting part of the solution to reduce local pollution and oil addiction by using renewable energies to compress air. Just wait and see a few more months, not years : AirPods are already running for tests in streets ! Any comment or question ? Regards, Marsupy .

MARSUPY 11.05.2009
Hello again ! "Dropping the pressure from 350 bars to 20 bars before the air can be fed to the cylinders wastes nearly half the stored energy" Do you actually think that Cyril and Guy NEGRE are so stupid to lose 50% of the little stored energy ? Have a look at this international patent and I think you may understand the weakness of your assertion : http://v3.espacenet.com/publicationDetails/biblio?CC=PL&NR=373005A1&KC=A1&FT=D&date=20050808&DB=EPODOC&locale=fr_EP I think it should be very interesting for Charlie ;o) Regards, Marsupy. .

MARSUPY 11.05.2009
2nd try... ============= Hello! This quite long paper needs yet more information. To understand advantages and drawbacks of compressed air tanks vs batteries, please see this bilingual post: h ttp://air-car-concept.bb-fr.com/stockage-et-recharge-f9/comparatif-stockage-energie-air-comprime-vs-accus-t188.htm#1427 ...and bring your questions and comments ! (english spoken on this forum) Regards, Marsupy..

MARSUPY 11.05.2009
Hello! This quite long paper needs yet more information. To understand advantages and drawbacks of compressed air tanks vs batteries, please see this bilingual post: http://air-car-concept.bb-fr.com/stockage-et-recharge-f9/comparatif-stockage-energie-air-comprime-vs-accus-t188.htm#1427 ...and bring your questions and comments ! (english spoken on this forum) About efficiency of air compression process: Hey! Wake up guys ! Reciprocating compressors are definitely old-fashioned ! ;o) With new types of compressors, designed by engineers from the famous "Ecole Polytechnique Fédérale de Lausanne"(EPFL, Switzerland), it's absolutely possible to compress air with an excellent efficiency (>78% !) thanks to liquid pistons or air-oil interfaces that allow an almost isothermal process. Today, best reciprocating industrial compressors have an efficiency of 50-55%. Sylvain LEMOFOUET, a young engineer that made his thesis on the subject, has just created a startup to bring this new invention to the market. See: http://www.bfe.admin.ch/php/modules/enet/streamfile.php?file=000000008102.pdf&name=240050.pdf http://leiwww.epfl.ch/publications/lemofouet_rufer_epe_05.pdf http://www.swissnexboston.org/activities/activities/vl_0207_eid_lemofouetsylvain_enairys.pdf or search his name on the web to see all his publications. That offers a efficient way to store renewable but intermittent energy (windmills, solar panels...). Moreover, this improve greatly the global efficiency of the air car and brings it nearer electric cars. Free bonus ! :o) Here is a very interesting report (.pdf in a .zip file: 1.7MB) from International Energy Agency about evaluation of different existing storage devices. http://mdi.cats.free.fr/Img/Evaluation_of_energy_storage_devices.zip It shows that compressed

air has its place ! :o) Regards, Marsupy..

RTATUM 11.05.2009
Ok, so it's not a perfect energy source for autos. However, in combination with conventional gasoline or battery power, it could be an alternate energy source for hybrids. There seem to be plenty of other uses for such a system too, like powering a home emergency generator or operating a lawn mower. The idea of not having to store a can of gas in the garage is appealing..

PETER FAIRLEY 11.04.2009
CHARLIE mentions Shiva Vencat's 20 mile range comment in a May 2009 story by the Associated Press. Such statements to the press alarmed MDI and in June the company asked Vencat (MDI's sole U.S. franchisee) to cease acting as a spokesperson. .

JFXY 11.03.2009
i would be cool if there were such cars in Belgium and if they work.

CHARLIE 11.03.2009
The article says "Dropping the pressure from 350 bars to 20 bars before the air can be fed to the cylinders wastes nearly half the stored energy." .... but MDI says their efficiency is 43% now and will go to 60% later. How can the tank-to-wheels efficiency be 60% if 1/2 the energy is lost in a tank-to-20 bar regulator? ....The 42 mile range estimated by Clodic of the École des Mines is more in line with MDI's claimed 43% efficiency being measured from the 20 bar pressure, not the tank. ....A director of MDI and CEO of the US franchisee of MDI, Zero Pollution Motors, has said that the vehicle intended for USA release has a range of about 20 miles on compressed air. Google "Shiva Vencat 20 miles"..

CHARLIE 11.03.2009
"So that leaves just 5.6 kWh to spin the AirPod¿s wheels. MDI vows that the production version of its engine will somehow do better, providing 6.2 kWh of mechanical energy where the rubber meets the road." Either 1) your calculations are wrong, or 2) MDI's calculations are wrong, or 3) MDI has invented the over-unity perpetual motion machine. #2 is my bet..

DIDIER 11.03.2009
Well thank you for this very extensive, well made and very up-to-date article. It is very instructive though less optimistic than I am. I have been following the air cars closely for quite a time now, and have made a website on them, called www.aircars.tk. So to anyone who is interested and wants to see lots of information, pictures, videos, links and the latest news, try it!.

CHANDRASEKAR 11.02.2009
this article gave me a valuable information about air pod.