

TTW Personal Commuting Vehicle

A new vehicle class for personal mobility

TTW is a highly innovative proposal for an emerging class of new vehicles: the Personal Commuting Vehicle (PCV). Only one meter wide, as short as a Smart, but with safety standards as regular city cars, TTW is combining the safety and comfort of a car with the driving excitement and maneuverability of a motorcycle. TTW exhibits a unique Active Tilt & Steer driving with electrical hybrid traction. TTW is a real, stylish and sound alternative to standard vehicles, both cars and motorcycles.

TTW is the first Personal Commuting Vehicle (PCV) that combines up-to-date technologies for plug-in hybrid electric powertrain, natural gas combustion engine, active tilt & steer control, integrated vehicle dynamics, structural optimization and crash proof safety. The vehicle is much safer than motorbikes and scooters, and much smaller and lighter than any car, perfectly fulfilling the desires of personal mobility.

TTW is a three wheel vehicle for two passengers seating in-line. It is fully enclosed with a crash proof frame and there is no need to wear a helmet. Active tilting allows the driver to steer like a car while the vehicle automatically leans into the curve like a motorcycle giving a completely new driving feeling. TTW PHEV technology allows to choose between driving up to 25 kilometers with zero emissions, increase the efficiency of the combustion engine propulsion or greatly boost vehicle performance (0-100 kilometers per hour in just 6 seconds). Electric motors conveniently located in the front wheel hubs allow a full electronic control of integral traction, hybrid driving mode and vehicle dynamics.

TTW offers green performance, a totally new driving feeling and state-of-the-art active and passive safety. More than ten worldwide patents are pending to protect its technologies.

Personal mobility

Mission of TTW S.r.l. is to design, engineer and profitably build a revolutionary new vehicle that is to be small, safe, highly efficient with a new driving feeling for the enthusiastic and environmentally minded driver.

TTW serves perfectly the purpose of personal mobility. It is a compact vehicle for two passengers in tandem seating, with a length of 2500 mm, width of 1100 mm and height of 1700 mm. The curb weight is no more than 400 kg, the wheelbase about 1900 mm. All wheels front and rear are 17" lightweight aluminum wheels. Given the three wheel footprint and the narrow width the vehicle is designed to tilt when cornering and has a computer-controlled tilting system which, together with the thrust of the two engine systems, results in an experience with tilting angles of up to 45° and zero lateral forces very similar to flying a sports plane.



TTW Personal Commuting Vehicle

Its low curb weight and a front-end surface area of just 1 square meter mean low CO2 emissions of less than 70 grams per kilometer. Its top speed is approx. 180 kilometers per hour, acceleration from 0 - 100 kph is 6 seconds and its range is limited to approx. 300 km.



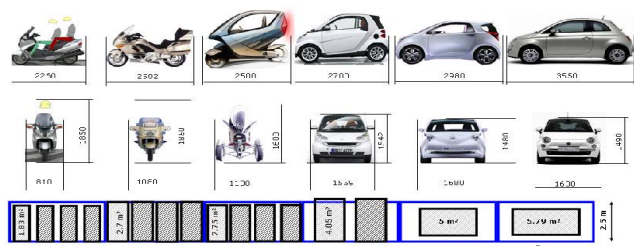
TTW - Personal Commuting Vehicle 090727.odt
Creato: 08-11-14 Rivisto: 09-07-27
Autore: Stefano Carabelli, Sebastian Gruender

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Three Tilting Wheels - TTW S.r.l.
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The resulting vehicle footprint is much smaller, the vehicle lighter and more drag efficient than a regular car, offering the perfect basis to environmental friendly driving. Light and narrow is by definition more efficient than wide and heavy. The small displacement powertrain (800cc) is enhanced by a hybrid power train, with electric motors enclosed in the front wheels, all of which accounts for a targeted fuel consumption of below 3L/100km.

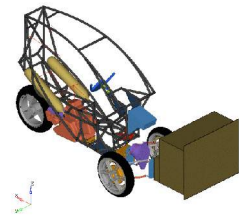


TTW is safer than motorbikes and smaller and lighter than any car

Full safety despite reduced size and weight

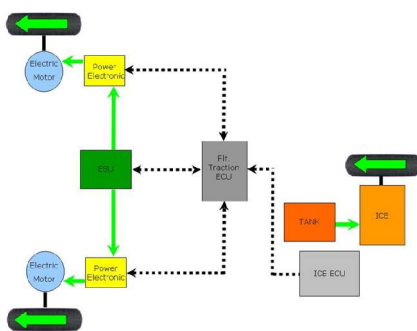
The vehicle is very different from previous attempts at efficient personal transportation, especially in terms of occupant safety. TTW is as safe as a regular small city vehicle, and by far safer than normal two wheelers. Its enclosed passenger cabin has been created in computer aided simulations and optimized in physical crash testing according to the European NCAP crash test, which is normally applied to cars. As a result, the occupants do not depend on helmets for protection and are also safeguarded from weather and wind.

It is generally accepted knowledge that active safety is one of the most important features buyers look for in a vehicle. On TTW, an actively tilting suspension adds active vehicle stability control and vehicle dynamics. Vehicle motion is constantly monitored and allows the vehicle to be steered like a car, while offering the driving fun and maneuverability of a motorcycle.



TTW crash testing for state-of-the-art safety

Green powertrain - Zero emissions or powerful boost



TTW Dual Mode parallel Hybrid system

The parallel hybrid power train of TTW offers a range of customer benefits, is as energy neutral as possible and maximizes vehicle range with today's technologies. In addition to reduced overall consumption and emissions, Zero Emission mode allows for driving up to 25 kilometers without any emissions, using only the electric power train. Entering city centers during emissions restrictions is assured for the driver!

On the other side, if a boost of performance is called for by the driver, the electric and combustion engines are both engaged to offer enormous boost. Performance can be further increased by the Plug-In option: a larger energy storage unit

for the hybrid power train and a cable for regular 220V home power outlets allows the batteries to be recharged at any power outlet, such as home and in the office, making the vehicle independent of regular fuel for a total distance of up to 300 kilometers of driving.

Driving excitement with Active Tilt & Steer

The vehicle's narrow footprint (no car, no motorbike) required the design of a totally new suspension that allows the vehicle to tilt during cornering. The electromechanical active tilting system is electronically activated and computer controlled. It assures that the vehicle automatically stays upright during standstill and lower speeds, and at higher speeds allows car-like steering while the vehicle leans into the curves like a motorcycle. TTW chose an electromechanical tilting system because of its immediate activation and reliable operation. The active safety features are completed by the fully integrated vehicle dynamics control that provides integral traction (3 wheels) along with the standard anti-skid and stability control.



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TTW drivers will likely use the vehicle in urban driving, even though longer distances or even highway driving are possible without any restrictions. To ease parking of the vehicle, the steering is power-assisted. A further innovation is the tilt-activated "assisted entry" mode: Before entering the vehicle, by push of a button the vehicle leans itself slightly away from the driver and makes vehicle entry much easier. Upon start of the engine, perfect upright position is already reached.



TTW testing on the racetrack

Elegance and Style

Being an innovative new vehicle full of technology, TTW will have a uniquely distinctive style. But of course, as a truly Italian product, elegance and sharpness in the design have been strongly emphasized. TTW is working with a leading Turin design studio to find a pure Italian style and the right elegant "skin" for this new vehicle.

The Progressive Insurance Automotive X PRIZE

TTW is an officially registered contender for the Progressive Insurance Automotive X PRIZE competition for highly efficient & low emission production-capable vehicles to be held in the United States in 2010. TTW is participating in the "Alternative Class" for commuter sized vehicles, and is competing for the total price purse set at \$10million.

For more information on PCV:

www.personalcommutingvehicles.com and en.wikipedia.org/wiki/Personal_Commuting_Vehicle

About TTW S.r.l.:

TTW S.r.l. is a highly innovative company based in Turin, Italy, developing a revolutionary new vehicle. The company's mission is striving to design, engineer and profitably build such a revolutionary new vehicle that is to be small, safe, highly efficient with a new driving feeling for the enthusiastic and environmentally minded driver.

TTW is a business unit of Actua, which is exploiting opportunities in Energy Efficiency Technologies. Actua has key know-how in new technology areas electric/hybrid powertrain, drive-by-wire, actuation and control rapid prototyping. TTW is also a spin-off of the Politecnico di Torino. For more information about TTW, please visit www.ttwvehicles.com or email info@ttwvehicles.com

About the Progressive Automotive X PRIZE Competition:

The goal of the Progressive Automotive X PRIZE is to inspire a new generation of viable, super fuel-efficient vehicles that offer more consumer choices. Ten million dollars in prizes will be awarded to the teams that win a stage race for clean, production-capable vehicles that exceed 100 MPGe (2.35 liters per 100 kilometers). The Progressive Automotive X PRIZE will place a major focus on affordability, safety, and the environment. It is about developing real, production-capable cars that consumers want to buy, not science projects or concept cars. This progress is needed because today's oil consumption is unsustainable and because automotive emissions significantly contribute to global warming and climate change. For more information about the Progressive Automotive X PRIZE, please visit www.progressiveautoxprize.org or email progressiveautopress@xprize.org.



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Technical Data:

VEHICLE OVERALL DIMENSION		
width	mm	1,100
length	mm	2,500
height	mm	1,700
wheelbase	mm	1,900
wheel track (front)	mm	900
front tire (dimension)	---	120/70 R17
rear tire (dimension)	---	180/55 R17
VEHICLE OVERALL MASSES		
Curb weight – Std A (empty + fluids)	kg	400
PERFORMANCE DATA		
max roll angle	deg	45
turning radius	m	9.0
max acceleration 0->50 km/h	s	<3
max acceleration 0->100 km/h	s	ca. 6
max acceleration 0->400 m	s	<15
braking 100 -> 0 km/h	m	<40
range (pure electric mode)	km @ 50	25
range (hybrid mode)	km	300
POWERTRAIN		
ICE powertrain power	kW	55
ICE powertrain displacement	cm ³	839.3
ICE powertrain torque	Nm	76.4 @ 5705 rpm
ICE fuel (gasoline, diesel, GPL, CNG)	G/D/GP/C	Gasoline/CNG
electric powertrain continuative power	kW	5
electric powertrain peak power	kW	25
SAFETY		
Crash test	NCAP stars	tbd
frame	type	tubular frame
frame material	material	high resist. steel

Subject to change without notice



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