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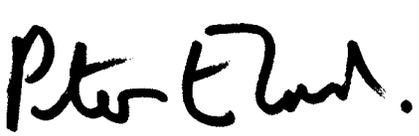
If you have any comments, problems or suggestions about the magazine in general, or this PDF in particular, please email me at

peter@velovision.com

I hope you enjoy the read!



Peter Eland
Editor and Publisher, *Velo Vision*

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COVER: Mikael Kjellman in his self made 'bicycle car'. Read all about it on page 12. *Photo: Mikael Kjellman*

OPPOSITE: Howard Yeomans rides the AZUB Tricon near Castle Howard (no connection!) in North Yorkshire. *Photo: Peter Eland*

Times of transition

I hope you enjoy Issue 48! As you will see, a number of the reviews and reports in this issue have been written by Howard Yeomans, a long-term *Velo Vision* reader with an aerospace engineering background, whose mobile bike repair service 'Bikes Made Good' we featured on the cover of Issue 41.

Over the next few issues Howard will be taking on the editorship and publishing of *Velo Vision*, and I'll be taking more of a back seat as advisor and contributor. As subscribers are aware, I have decided to 'retire' from magazines after some 20 years of publishing – it's been a privilege, but it's time for a change, to recharge my cycling batteries, and maybe to take on a new challenge.

We'll try to make the transition as seamless as possible: for now, please keep using the same contact details, and we'll introduce Howard properly in Issue 49. Nor is this the time for goodbyes – I'll be with the magazine for a while yet. At this point let me just thank you all for your support and contributions – please do keep them coming!

Peter Eland

BUILDING THE BICYCLE CAR

A video clip showing a four-wheeled cycle car skidding around on a frozen lake popped up online in late 2014, and 'went viral', in the world of interesting bikes at least. We posted it on the *Velo Vision* Facebook page, with a plea to identify the builder, and within hours we'd been put in touch with the maker by one of our readers from Sweden.

Behind the cycle car is industrial designer Mikael Kjellman from Frösön, near Ostersund in Sweden. He describes now how his design evolved to its current format: a highly practical and attractive bicycle car which is seeking a partner company to take it towards production.

BACKGROUND

I like riding bikes and have cycled to work, both summer and winter, for many years. It's good exercise, cheap and good for the environment.

However, it can be quite uncomfortable, and a little dangerous too, especially in winter. Studded tyres and rain gear work quite well of course, but it's not always fun. So I have often wondered whether it would be possible to create a more comfortable, safe and weatherproof bike.

The first idea was inspired by alpine sit-skiers, as used in the Paralympic ski events: there's a seat instead of a saddle, but you can still lean into corners for a dynamic ride, controlled by mini outriggers for each arm.

So I built a sort of two-wheeled recumbent sit-ski, with movable support wheels for each arm to balance. But I never got it to work properly: I felt too weak in the arms for it to work well and feel safe.

After this, I built a three-wheeled recumbent bike (pictured right) with two front wheels and one rear. This one I rode for a couple of years until I started working further from home. At that point the journey was taking too long, and I was arriving too sweaty, to carry on with this rather heavy trike.

So the next attempt was to build a two-wheeled recumbent bike. This was more efficient and faster, and it worked well through the summer. But for winter cycling it was just too unstable and difficult.

The next development in my search for safe and comfortable commuting was the purchase of an electric bike with a 250W electric motor built into the rear wheel. It was both easy and quick to ride, and it was great fun, too. But though it's faster, it can also be colder (because the motor is doing much of the work) and in winter especially, it was easier to skid. It felt better than the two-wheeled recumbent but it was still sketchy.

Eventually, the idea came to me to fit the electric motor hub onto my old recumbent trike. This turned out to be a really successful solution. My slightly heavy and sluggish tricycle suddenly became fast, easy to ride and fun!

ABOVE: Initial design sketches and CAD models: the design took a while to evolve.

This inspired me to go ahead and start to sketch out an all-new design, taking into account all of the lessons learned so far:

- *You should sit on a proper seat with padding.*
- *You should have suspension.*
- *You should have a stable platform (at least three wheels).*
- *You should have a small power assist motor.*
- *You should have protection against the weather.*
- *You should be able and allowed to use cycle paths.*
- *You should sit at the same height as in a car.*

THE BICYCLE CAR

After some consideration and reflection I was ready to construct a new craft. It is a four-wheeled recumbent with fabric body, suspension and an auxiliary electric motor.

I chose four wheels instead of three despite the slight extra weight so as to make the vehicle as small and as narrow as possible. I think this is crucial so that it can use existing cycle routes, and a compact machine is also important for storage, parking and transport in other vehicles.

The seating position is fairly low, as on a recumbent bike, to achieve a comfortable riding position and to bring down the centre of gravity. But I also wanted the seat height to be the same as that of a passenger car, to see easily and to be seen in traffic.

The bicycle car is equipped with air suspension both front and rear. This may sound like a luxury and unnecessary, but one drawback to sitting in a seat is that you become more sensitive to larger bumps and kerbs. A conventional cyclist can stand on the pedals instinctively to ride over a bump, but that isn't possible here so suspension becomes essential.

When it came to the electric motor, a 250 W brushless hub motor powered by a lithium battery was the obvious choice. This type of system is widely available as complete kits. In most European countries, if the power is limited to 250 W and the motor cuts out at 25 km/h, the vehicle is still officially classed as an ordinary pedal cycle. So no driving license, tax, or insurance are needed.

The body is made from fabric over a framework of aluminium tubing, with plastic windows. This is a light and inexpensive solution which also can be easily manufactured in different versions: sporty, elegant, cute, convertible and so on, but all using the same basic structure.

ON THE ROAD

Now that I am working in Vapland, I have 30 km of single track road as my commute. I was worried that it would be too hard to cycle this distance, but I tried it in the first week after building the bicycle car.

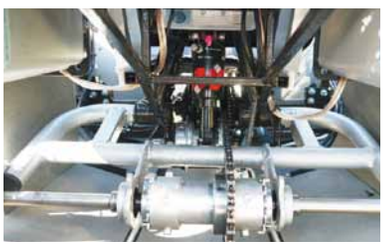
It worked out very well! The electric assist made such a difference that it was really no hassle. Certainly this commute is at the longer end of the range that is practical, as it took over an hour, and I was quite sweaty when I arrived. But it worked and was really good fun. I charged the batteries at the office and rode home, too, making 60 km in a day, and without soreness. I think that is pretty good!

COSTS AND BENEFITS

Other 'bicycle cars' which I have seen advertised cost between € 6000 and € 12000: these are three-wheeled velomobiles, usually with fibreglass bodies. They are built to a fine quality level, with advanced materials. This, and the small scale manufacture, leads to the high prices.

Unfortunately, I think my bike car would be almost as expensive if made in small numbers. If a large production run was possible, though, I think it

RIGHT: At both front and rear, the suspension system has single shared swing-arms for both wheels.



RIGHT: The transmission system is rather elaborate, with gearing systems both before and after the mid-mounted electric motor.

RIGHT: Two battery packs are fitted behind the seat, and there's space on top of them for luggage.

RIGHT: The aluminium framework for the fabric fairing is lightweight and easily adaptable to create different styles.

FAR RIGHT: An earlier prototype used foam panels rather than fabric.

could cost between € 2000 and € 3500 to the end user.

As well as the production cost, it makes sense to look at the cost per kilometre. If you only count the electricity, riding a bicycle car looks very cheap: about € 0.4 per 100 km.

But it is not charging but battery replacement which is the major cost of today's electric vehicles. Adding battery costs gives about € 2.5 per 100 km. This is still much cheaper than a moped, which with petrol and insurance comes to € 10 to € 20 per 100 km.

Even more important than the cost saving is the environmental benefit. An average passenger car emits around 1890 g CO_2 per 10 km. A Toyota Prius hybrid (among the best cars) still emits 1040 g CO_2 per 10 km. Even a scooter gives out 528 g CO_2 per 10 km.

The bicycle car does not emit anything at all! But indirectly, of course, it is responsible for some emissions. Charged by European electricity generated from plenty of coal and oil, the emissions come to about 68 g CO_2 per 10 km. If charged using Nordic, more hydroelectric power, this reduces to about 20 g CO_2 per 10 km.

This makes the bicycle car 94 times better than the car, 54 times better than the hybrid and 26 times better than the moped!

And if even this is not enough for you, you could buy green electricity generated purely from wind and hydro power with almost zero CO_2 emissions. It costs a bit more, but a few percent extra on 40 Euro cents per 100 km is hardly worth worrying about.

FUTURE TRANSPORT

While I was working on the bicycle car, I came up with a possible future transport system. It would work something like this:

You take your cycle car and ride 5 km to the bus station in your local village. There you sit warm and dry inside your vehicle as you wait for the bus, despite the drizzle and biting wind. The bus routes are much quicker, and the buses more frequent, now that the bus just runs between village centres. Previously, it would travel around the whole area, to pick up and drop off passengers near their homes.

When the bus arrives, you drive the cycle car on board! It would be designed to latch onto hooks in the floor, and you could stay sitting in your vehicle during the trip.

When you arrive at the destination bus station a few minutes later, you unhook, ride off the bus and cycle the final few miles to work, school, or wherever you need to be. When you arrive it's easy to park, and you will be warm and dry whatever the weather.

SPECIFICATION

Length: 180 cm
Width: 75 cm
Height: 145 cm
Seat height: 50 cm
Weight: 70 kg
Wheels: 20" (406) tyres
Wheelbase: 88 cm
Turning radius: 1.75 m

Motor: 250 W hub motor, two 360 Wh batteries.
Speed: 25 km/h with the motor
Range: 60 km with motor

Front axle: Shared swingarm with air suspension (8 cm travel), lever steering, drum brakes.
Rear axle: Shared swingarm with air suspension (10 cm travel), drive to both rear wheels via dual freewheels.
Gearing system: 18 speeds before the hub motor, and 14 speeds after.

LEFT AND BELOW LEFT: The top of the fairing hinges forward for access.

BELOW: The prototype bicycle car features a full set of car-like rear view mirrors, headlights and indicators, as well as plenty of refective material.

FURTHER WORK

There are plenty of improvements possible for the bicycle car: the big ones are a lighter frame and an improved transmission. I also miss several practical features such as rear wheel brakes, reverse gear, trailer hitch and heated front windscreen. I am about to start work on the windscreen: the heating wire is at the post office.

The weight, at 70 kg, is pretty heavy for pure pedalling, but with electric assist it is not of such great significance. I estimate 65% of the weight is in the chassis, 20% the frame and cover, and battery/motor 15%. I did not make any great efforts to keep the weight down; I was focused on building a working prototype, so there is great potential to build a much lighter model in future. But it works so well despite the weight that I think it's even more important to keep the price low than to build a lightweight model.

FINAL WORDS

The project aims to develop and promote cycling in the form of an environmentally friendly cycle-car.

I will of course try to commercialise the bicycle car, but as an individual designer and inventor I do not have the resources to start making and selling a complex product like this. Also, it is probably not possible to patent the concept: it is essentially a new/improved version of existing cycle cars.

That is not to say that patents could not be taken out on some of the particular solutions used, or that it might not be a good business prospect for someone with the right resources necessary to commercialise it.

My purpose was originally just to build a simple velomobile for my own use. But when I realised just how practical and environmentally friendly it turned out to be, I decided I had to try to get someone to mass produce it. So I am trying to spread the word with articles like this.

I would love to hear from anyone who thinks it is a good project and might want to help. Or do you have any suggestions? Please feel free to get in touch!

Mikael Kjellman

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