

# **E-Bicycles – Bicycles or Mopeds? Overview about the project “SEEKING – SAFE E-BIKING”**

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**Abstract** - SEEKING is looking for answers regarding electric powered bicycles and their relation to traffic safety issues. Does a cyclist need “E”? Is it as risky as riding a moped or are E-bikes creating conflicts with other cyclists? The project described herein, funded by the Austrian Ministry of Transport, has the aim of seeking answers to these hot topics. The SEEKING-team shows an in-depth investigation of vehicle dynamic sensing, together with subjective feedback of test riders to detect similarities and differences between conventional cycling and E-biking. Following an overview on the international status quo, measurement runs and their analyses are performed to find a set of preventative measures to make (E-)biking safer. A specific focus is the detection of curve handling, stopping and acceleration phases as well as conflict studies on course-based test rides and “real world” tests on cycling paths (naturalistic riding).

## **INTRODUCTION**

This project was funded by the Austrian Road Safety Fund. It aimed at seeking answers to road safety related topics regarding e-bicycles and e-mopeds - especially for policy makers who develop roadmaps for the safe integration of electric powered bicycles and mopeds into regular road traffic. Finally, the results led to a catalogue of safety measures, e.g. legislative policies, infrastructural measures and technical rules (norms) for manufacturers to design reliable and safe electric two-wheelers.

Following a state-of-the-art analysis, the SEEKING-team (AIT Austrian Institute of Technology; BOKU Institute for Transport Studies at the University of Natural Resources and Life Sciences; KFV Austrian Road Safety Board; Government of Carinthia; Strombike.at) performed an in-depth investigation of vehicle dynamic sensing together with face-to-face interviews of test riders to detect similarities and differences between conventional cycling/moped riding and e-biking/-riding.

## **BACKGROUND**

The riding characteristics of an electric two-wheeler differ from an ordinary bicycle, or a two-wheeler driven by a combustion engine (moped, scooter). The electrical support enables higher start-up acceleration and higher average velocities for e-bicycles. It is expected that these higher average velocities and changed acceleration behaviour result in increased conflict potential with other cyclists/road users.

Due to the lack of efficient passive protection, cyclists generally bear a raised injury risk in case of an accident. Compared to vehicle occupants, cyclists show a 4-times higher accident severity. Since this risk or rather the number of bicycle accidents is expected to increase with a rising number of e-cyclists, the main objectives of the SEEKING project are the expected changed driving characteristics and their influence on road safety. Within the scope of SEEKING, specific safety aspects for e-two-wheelers (e-bicycles and e-mopeds) are examined and relevant measures for increasing road safety are developed.

Riding dynamic effects and their consequences for e-cyclists and e-riders were scientifically compared to those of conventional bicycles and mopeds. Furthermore the conflict potential due to the interaction of e-cyclists with other road users was enquired and analysed. Following this analysis, preventive measures were derived for the safe use of electric two-wheelers.

## DEFINITION

Since the development of single-lane two-wheelers with electric drive, many technical variants with different names were established on the market. Various names, as for example e-bicycle, e-bike, Pedelec, e-moped, e-Scooter, electrovelo can partially be assigned to technologies, be rudimentarily defined in legal sources, or be considered as vehicle type designation of manufacturers or distributors. Electric two-wheelers are vehicles, which are pedal powered or non-pedal powered driven by an electric engine; the power supply is a (usually removable) battery pack. Depending on engine performance and design speed a classification according to Austrian law is as follows:

- “Bicycle” regarding the definition in the Austrian road traffic regulations (StVO, [1]) or as
- “Powered Two-Wheeler” (implies regulations regarding engine driven vehicles and driving licence) (EU directive in 2002/24/EG or §1 Abs 2a KFG [2]).

In this report the term electrical bicycle (abbreviated as e-bicycle) is used for single-lane bicycles with electrical pedal power. This corresponds also to the common term „pedelec“. The terms e-bicycle and pedelec are synonymously used in this case. Non-pedal powered two-wheelers with an electric engine are called electrical mopeds (abbreviated e-mopeds).

In summary this report defines and uses:

- Electrical bicycles (abbr. e-bicycle) for electrically supported bicycles, which are equipped with pedals, drive is dependent or independent from pedalling (in case that they do not exceed a maximum speed of 25 km/h).
- Pedelec (Pedal Electric Cycle) for the most frequent model of these e-bicycles, having the electrical support only if the pedals are moved; in Austria a pedelec is legally regarded as a „normal“ bicycle, if it is equipped with an electric drive with a highest permissible performance of max. 600 Watts and a design speed of max. 25 km/h [in accordance with. § 1 Abs 2a KFG].
- Electric moped (abbr. e-moped) for electrically operated two-wheelers, which have no device to use human driving power. The e-moped with a maximum design speed of 45 km/h and a maximum nominal continuous power of 4 kW is considered therefore as a powered two-wheeler and is referred to the subcategory “Motorcycle Bicycle” [in accordance with. § 2 Abs 1 Z 14 KFG].

In statements regarding all mentioned electrically supported or powered two-wheelers, the generic term e-two-wheeler is used.

## METHODOLOGY

At the beginning of the project, the state-of-the-art regarding e-two-wheelers was investigated, including an enquiry on legal regulations. An analysis of national and international studies and the European (EU directive 2002/24/EG, [3]) as well as Austrian legislation (§1 Abs. 2a KFG) in the area of e-two-wheelers was carried out. The legal definition of e-bicycles and their difference to e-mopeds are particularly relevant. Information about known risks of the use of e-bicycles and e-mopeds and enquiries about critical facts/driving conditions when interacting with electric two-wheeler and other road-users were made.

Existing measures to increase road safety were identified and summarized from literature. Users of e-two-wheelers were briefly characterized, the trip purposes of e-bicycles and e-mopeds were indicated and motives for and/or barriers against the use of these vehicles were described. Conflict potentials as well as safety and accident risks, which result from using electric two-wheelers, were documented on the basis of existing studies. Aspects on driving dynamics and vehicle technology, road safety-relevant aspects of electric engines, sensor technology, battery technology, vehicle usage, handling, etc. were investigated and summarized in detail.

In order to examine the driving dynamics with e-bicycles and e-mopeds, test rides including different driving manoeuvres (acceleration, targeted braking, driving along curves etc.) with test persons were accomplished and data (speed, acceleration etc.) automatically stored. By means of face-to-face interviews, subjective experience and feedback of the test rides, attitudes to safety-relevant measures as well as personal behaviour and strategies for safe traffic participation with the electric two-wheeler were surveyed.

The synthesis from test rides, interviews and literature analysis finally resulted in a catalogue of safety measures as recommendations for increasing road safety of electric two-wheelers.

## **MAIN ACTIVITIES OF “SEEKING”**

The three main topics of SEEKING are driving dynamics, conflicts and road safety measures.

### **Driving characteristics/dynamics**

Driving characteristics/dynamics were measured and stored with GPS and three-axial accelerometers, using compact sensors (Smartphones) to ensure a quick and simple installation and not to affect the driving characteristics of the bicycle and/or the moped by the sensors including their power supply (weight, dimensions, etc.). In the first phase, analysis of driving dynamics and differences between e-two-wheelers and conventional two-wheelers took place on closed test courses under controlled conditions. Apart from the driving dynamic sensors, the provided bicycles and mopeds were also equipped with devices for data storage (by means of circular buffering). The evaluation of data clearly showed differences in the driving behaviour. Every test person drove the requested turns in a course (separate courses for bicycles and mopeds), with the target to drive each turn with similar time and speed. For both modes (electrical and conventional), 5 turns were driven (in sum 10 turns per participant). The adaptation effects while using e-two-wheelers were also examined. The subjective feedback of the rides was also recorded in detailed interviews.

### **Conflicts with others road users (only with e-bicycles)**

In the second phase of field tests („Real World Study “), e-cyclists were observed during “normal” traffic flow on cycle paths, and potential conflicts were recorded by video (Smartphones). Driving behaviour patterns or critical situations especially due to the interaction with other road users were examined; however, they were very rare thanks to the forward-looking driving manner of the test persons.

Similarly as during the course tests, subjective experiences were surveyed by means of face-to-face interviews.

### **Road safety measures**

The main objective of the research project was, to work out road safety-relevant aspects due to the usage of e-two-wheelers systematically. This was accomplished by a synthesis of the evaluation results from literature, the examined test rides and the interviews. Possible risk potentials were identified and specific countermeasures were derived. The individual views of the test persons regarding different safety-relevant topics were gained in the interviews. Increased road safety, based on “pro-active” solutions and awareness raising measures, was the focus of the project SEEKING. The results were documented in a catalogue of measures.

## **SENSOR AND DATA ACQUISITION**

For data acquisition a Smartphone (Samsung Galaxy S2) with light and compact sensors was used. GPS speed, three-axial acceleration and three-axial angular acceleration pitch, roll and yaw as well as a front video (fish-eye lens) were acquired and stored with the same device.

For sensor fixing special mounting plates were developed, which were equally applicable on every test vehicle. Therefore all e-bicycles and e-mopeds were equipped with the similar recording and sensor unit. Special attention was given to a stable fastening, without changing or damaging the vehicle frame.

A special software application (App) was developed, in order to capture and store data in parallel. The mobile measuring sensors were accessed by a basis station (laptop) via WLAN. With a specifically developed recording and controlling software, an operator could switch the app on/off, enter vehicle types, set time stamps manually or enter conflicts remotely, while the test person drives on the course. In between the test rides, data were transferred to a server automatically.

## **RIDING EXPERIMENTS AND INTERVIEWS**

First the specific design of a course was drafted, in order to be able to record the different driving manoeuvres and features. In a further step the driving habits were tested and the design of the course was finalised. It showed a distorted form of an eight, with a straight entrance lane, different radii and curve lengths, two straight sections and one stopping field, where each test person had to stop at every turn.

The area for the course, which looked equally at each test, required a space of 17m x 25m. The design was prepared to allow typical inner-city manoeuvres and speedy accelerating on intermediary straights; however it was not possible to speed. Thus the driving conditions were partially demanding, while minimising high accident/injury risk for the test persons.

The e-bicycle test rides were carried out in Klosterneuburg/Lower Austria and in Vienna during the Vienna Bike Festival 2011 at the Rathausplatz. In total, data (measured vehicle dynamics and interviews) from 145 persons (141 interviews were recorded. They performed accident-free, but not always completely problem-free. Some additional measurements, as well as individual interviews (of experienced e-bicycle users, who did not want to do the test rides) were accomplished, in order to gather a larger amount of data and information. The course was driven with two different bicycle types (a city bike and a folding bicycle); in each case five turns with the conventional bicycle and five turns with the electrical drive (Pedelec; 250 Watts of rated power output). There were differences particularly in the engine control units and the pedal sensors, which were clearly reflected in the results of the observations.

The e-moped tests took place during a SAFEBIKE event (MA46) in the driving camp Pachfurth/Lower Austria. 60 test persons took part in the test rides and interviews. The course design was taken from the e-bicycle tests with a 1.5-times increase in size. The test vehicles (loans from the company FABER and Post AG) were of identical design, one equipped with a 50 ccm two-stroke combustion engine, the other one equipped with a 1400 Watt electric engine.

Some problems and differences during the test rides became evident (also later on during detailed video analysis). No participant crashed; nevertheless some critical moments were observed and recorded.

These moments consisted of 3 specific situations:

- o Putting the foot on the ground to avoid a possible crash (foot off the pedal)
- o Touching the borderline, sometimes knocking over of the cones
- o Leaving the course (run-off)

57 conflicts were recorded during the bicycle tests. An accumulation of these incidents occurred during the use of electric power (39 conflicts with 18 riders) compared to rides without an additional drive (18 conflicts with 12 riders). There were no differences comparing the bicycle types (Citybike

(28), folding bicycle (29)). As expected more difficulties were reported referring to the curves than to the straights.

In the conflict study (real world test) (with rainy weather and tricky manoeuvres) at a mixed walk- and cycle-track (Wörthersee in Carinthia) no single problem was observed. Only experienced e-cyclists were invited to these tests.

For the e-mopeds the incident “foot off the pedal” got replaced through “extreme inclination in the curve, so that the stand is touching the ground”. The total number of conflicts was 22. No remarkable problems were encountered during the use of e-mopeds (11 conflicts with 8 riders using the electrical drive, 11 conflicts with 10 riders using the combustion engine). The e-bicycle and e-moped analyses are based on technical findings of the vehicle dynamics, which were measured in the trials and on the statements of the interviews.

Structure and content of the survey were primarily oriented towards the research questions and particularly towards road safety of e-cyclists and e-moped riders. The basic concepts of the questionnaires for both modes were similar, but particularly adapted to vehicle-specific characteristics and questions.

The focus of the qualitative interviews was on:

- o Self-assessment of the test persons with regard to driving skills using the e-bicycle, experiences and behaviour in traffic situations;
- o Transport policy attitudes regarding road safety issues of e-bicycle and/or e-moped, acceptance of measures;
- o Reflection of the riders’ experience in the test course.

After contacting the test persons, the process of the interviews was roughly divided into three parts:

- (1) Questioning before the test ride,
- (2) test ride with observation of the test persons by the interviewers,
- (3) Reflective questioning after the test ride.

The measured test ride data and interviews with the test persons were analysed regarding road safety-relevant issues and possible risk potentials.

#### Analysis of vehicle dynamics and interviews

Evaluation of the test-ride data and the interview results give an explanation about vehicle handling and riding behaviour with e-bicycles (in a test situation) according to vehicle types and different sociodemographic characteristics, and about experiences, self-estimation and attitudes towards bicycle transport policy measures.

It must be emphasized that due to the relatively small sample size no representative results could be achieved, but trends and characteristics of e-mobility in general can be derived.

The data analysis (plausibility tests) and evaluation of riding characteristic data, as well as the interviews were accomplished after completing the course tests. The data collected during the test trials by different sensors were examined. Data of the three-axial acceleration sensors (longitudinal x, lateral y and vertical z-acceleration) and gyroscope (roll, pitch and yaw three-axial angular accelerations) were corrected by separately measured calibration data and the (measurement) noise was removed (by smoothing). Based on the received yaw angle acceleration the actual yaw angle (heading) was determined by integration and trend analyses by means of section-wise linear regression models. With the aid of this signal and the longitudinal acceleration, starting and stopping manoeuvres were recognized. In addition, 6 specific course sections with different yaw angle were detected, corresponding to the 3 straight lines and the 3 curves of the eight shaped track. The section recognition was realised by a hidden Markov model.

For further analyses the measured rides and/or individual turns of the trials were removed, in case they contained severe conflicts and were classified as distorting and not representative in a manual examination (including the videos).

The analysis of the interviews was carried out independently. The focus was on descriptive analysis, since the majority of the acquired data had nominal or ordinal character. The evaluation itself was oriented on the categories of the interviews and was analysed gender-specific.

It delivers information and answers to following contents and questions:

- o Sociodemographic data of the test persons (gender, age, education, possession of a driving licence);
- o Experiences with e-bicycle or e-moped, e.g. opportunity and frequency of use, experienced conflict situations in road traffic;
- o Strategies of the active cyclists and e-cyclists to be safe in traffic (e.g. defensive driving habits, respect to pedestrians, giving priority to the road users, use of cycle paths);
- o Objective and subjective safety (safety feeling when cycling, helmet use);
- o Estimation of reasons for dangerous situations for e-cyclists and others;
- o Acceptance of bicycle traffic measures (e.g. mandatory helmet use, speed limit, mandatory use of cycle paths, number plates for cyclists);
- o Evaluation of the test rides - evaluation of the test persons by the interviewer and self-assessment of the test persons.

During the e-bicycle tests 141 persons were asked in four days and at two locations (Klosterneuburg and Vienna), 137 of them participated in the course tests. Although attention was paid to have a well-balanced ratio of men and women, all age groups and of persons with and without e-bicycle experience, this goal could not be realised. The majority of the asked and recruited ones were men (71%) and only approximately one quarter of the test persons had experience with e-bicycles. In the e-moped-tests in Pachfurth (NÖ) the sample was 60 test persons with 93% male participation.

Due to the small sample sizes and the unequal distribution of the interviewed persons, no representativity of the results (i.e. no complete coverage of the population) is claimed. The output of data analysis refers to the gathered sample. Nevertheless recognizable tendencies and interpretations with regard to recommendations are tolerable, in particular when the results appear plausible in comparison with literature research.

## **RESULTS OF THE DATA ANALYSIS**

The measured vehicle dynamics data were evaluated exploratively. Due to only partial control over gathered data, it could only be specified partially, which methods and statistical procedures were suitable, in order to receive information and answers to the project questions. Thus the provided evaluations were constantly adapted and the data were continuously fitted, depending on the insights supplied by proceeding analyses. Due to the descriptive kind of the evaluations graphic methods gave a fast and exact idea of the data. The used analyses are described briefly.

The basic contents were boxplots, histograms and density estimations, or their combination (violin plot). They all reflect different aspects of underlying distributions and cover many of the substantial parameters (three-axial accelerations, riding times per turn, angle of inclination, etc.). Estimation of a probability density function was done to avoid the problems of a simple histogram.

First analyses especially dealt with the influence of the numerous factors, which arose during the measurements. This was realised through an explorative data analysis, which divided the measuring data into specific groups and compared the resulting data distributions. In order to exclude a strong adaptation effect, the total number of 428 single analyses was split and analysed separately by the respective measured test turn 1 and 2 and the turns 3, 4 and 5. The adaptation effect, in order to be

familiar with a e-bicycle, was measurable, and even slight differences between the tests in Klosterneuburg (more place for free riding prior to the test rides) and Vienna (cramped area, no riding possible prior to the test rides) were observed.

It was shown that apart from the use of the electric engine, the gender of the test persons had an influence. Looking at the variance („width“) of the estimated density curves for longitudinal acceleration, it is decreasing between “without engine” to “with engine” for both genders, and between men and women both without and with engine support. A higher variance points to more extreme acceleration values. The differences, ranging from 0.2 to approximately 1 m/s<sup>2</sup> and appearing to be small, are to be considered as highly significant regarding their distribution. A Levene test examining equality of variances confirms this ( $p \ll 0.01$  in all cases).

## **RESULTS OF THE VEHICLE DYNAMICS ANALYSIS/TRIAL DATA**

- o Differences between the test days were detectable; a longer learning period and a good briefing of the technology were favourable.
- o Differences between the turns 1, 2 and 3, 4, 5 existed, there were recognizable learning effects.
- o Differences between bicycle types (size, operability) were measurable but negligible.
- o Differences between genders were obviously larger than between without/with electrical engine support.
- o For most combinations (type of bicycle, gender, age etc.) it can be stated: with electrical engine the ride got faster (i.e. shorter time per turn); the differences are not very distinctive.
- o With increasing skill a (slightly) better usage of the electric drive was evident, i.e. shorter times per turn and higher speeds were obtained.
- o Extremely slow turn times in the course occurred for test persons with little bi-cycle experience or for extremely careful persons.
- o Pedalling sensors and engine control units were relevant: the echo-sensor (a ring equipped with magnets) knows only On/Off of the engine and gives 100% performance; the pedal torque sensor had a time lag - this led to retarded accelerating and requires braking in bends (a moped driving style).
- o Differences in acceleration behaviour - problems concerning vehicle stability and during braking.
- o In the „Real-World Study” the test persons were experienced e-cyclists there were no problems (more experience meant safe handling of electrical bicycles).

## **RESULTS OF INTERVIEW ANALYSIS**

The majority of e-cyclists can be described as male, well-educated and middle aged (45 - 60 year old) - an insight from the interviews, which is well covered by literature. In spite of rising sale figures in Austria, experience with e-bicycles is relatively small. Among 141 test persons, 34 persons (18 men and 6 women) had active e-bicycle experience, completed by 22 experienced test persons from the real world study in Klagenfurt. Conflicts with other road users in traffic exist but were reported rarely: Asked about dangerous situations with other road users (passenger car, cyclists, pedestrians) only one man with e-bicycle experience (in the parcours tests) answered with „yes“ (without any further details); all others had no conflict or accident at all. However nearly two thirds of the interviewees already experienced conflicts or dangerous situations while („normal“) cycling, in which conflicts with car drivers were most frequent (55%) compared with 30% cyclists and 29% pedestrians. These experiences corresponded with those of the e-bike experiences interviewees in Klagenfurt. They indicated priority violations through car drivers and inattention of pedestrians as problems in traffic. 27% of them already had conflicts with car drivers, 14% with other cyclists and 9% with pedestrians. However they added that the conflict frequencies with the e-bicycle were not higher than with the

conventional bicycle. Nevertheless it is expected that e-cyclists have more conflicts than conventional cyclists due to the higher speed level.

Women generally indicated to feel safer while riding a conventional bicycle than riding an e-bicycle. Moreover, they seemed to be more cautious about their personal safety than men: They more often use a bicycle helmet. If men rode an e-bicycle, the helmet usage rate also rose in comparison to the usual bicycle.

E-cyclists are aware of the dangers and risks in road traffic and adapt their driving behaviour accordingly. Following the interview data (at the course and also at the Real World Study) they show respect for pedestrians, ride defensively in general, with adapted speed and ready to brake. Due to the numerous gaps in the bicycle traffic network, not only the bicycle paths are used, but also the carriageway and sometimes even the sidewalk.

The majority of the test persons handled the test course safely, which was approved by the observations of the interviewers and by the self-assessment during the test trials. The few uncertainties arose more frequently with the e-bicycles (narrow curves, higher speeds as well as sudden acceleration with the e-bicycles) and particularly by women; the test rides with the usual bicycles rarely caused problems. - Test persons felt very safe with the bicycle - men to almost 100%, women were more critical. Also the Real World Study in Klagenfurt delivered no single conflict and problem; the majority of the test persons could always control the speed well and safely accomplished even the up and down riding of the cyclist bridge.

Asking about infrastructural conditions and circumstances for the e-cyclists, the majority of the interviewees rejected the suggestion to be just allowed riding on the road instead of using bicycle paths. E-cyclists would like to have the possibility to use cycling paths - particularly women feel safer there - and would like to have a suitable infrastructure available. The quality of the bicycle lanes, specifically their width („too narrow“) was criticised by two thirds of the interviewees. It was interesting, however not surprising, that men rejected a speed limitation for e-cyclists, while more than half of the women agreed on that point.

The test persons were finally asked to give feedback on possible measures for a safe participation as e-cyclist in road traffic. The acceptance of a mandatory helmet use for e-cyclists was rather high (argued with higher average speeds with an e-bicycle compared to conventional bicycles). The opinions were matching with the personal data regarding the bicycle helmet usage, for which women again showed a higher acceptance. However a registration plate including insurance for e-bicycles was rejected by the majority. An obligatory bicycle examination (of traffic rules) was accepted among women, while obligatory bicycle training was rated rather unnecessary by men. However the latter is quite supported by experts, particularly for seniors and persons, who have not ridden a bicycle for long time.

## **FINDINGS OF “SEEKING”**

The interpretation and knowledge from all evaluations (analyses of vehicle dynamics data, survey results and observations on site) prove, after reflecting the research questions and hypotheses, the following summary:

Differences of the riding dynamics between conventional bicycles and electric bicycles are definitely measurable and exist. While the recorded differences in the data with conventional mopeds and electric mopeds are neglectable small. Among the electric bicycles every vehicle model had own vehicle dynamic characteristics which are to be explained by different drive concepts and control units. Measured engine lag and inharmonious acceleration phases led to noticeable problems at the warm-up turns of the test rides. Clear differences, e.g. of the lap times, speeds, acceleration peaks etc. were identified driver-specific. The rider's behaviour had a stronger influence on the riding manner and therefore on road safety critical situations than the vehicle types itself. The evaluations of the interviews showed the good self-assessment of the test persons and an absolutely high road safety



consciousness. The feedback of the riders' driving experiences and impressions were highly relevant for the analyses and interpretation of the measured data of the respective interviewee/test person.

The knowledge about riding experience and enrolment phase, especially at the track tests, was highly relevant. After two laps in the course almost all test riders were consistently and without any conflict on the move. During the familiarisation phase (bicycle and e-bicycle) the most problems were observed and documented with e-bicycles. At this point, it must be stressed that especially for beginners and returners' special training with an e-bicycle is highly recommended. In the test rides with (e-)mopeds no relevant conflicts were detected.

Based on the experiences from the course trials, the hypothesis whether experienced e-cyclists could handle e-bicycles safer was examined in the real world test in Klagenfurt on a challenging segment of a mixed pedestrian and cycling path. The hypothesis was confirmed to 100% – not a single conflict was registered. Only the rainy weather on the test day brought new knowledge relevant to road safety issues.

To every identified increase of the accident risk a suitable preventive measure, which was summarised into a catalogue of measures, was defined.

## **CATALOGUE OF MEASURES**

To increase the safety of e-bicycles, the results of the literature research and the test runs were assembled and measures for road safety were derived. The measures can be structured into five categories:

- Legislative measures: Legal harmonisation of the Austrian regulations on the European level (especially concerning the definitions of e-bicycles and pedelecs), regulations regarding helmet use and offer of tests and training for e-cyclists.
- Infrastructural measures and traffic planning: A generous dimensioning of infrastructure according to the Austrian guidelines for bicycle traffic (cycle paths, intersections, curves etc.), integration of bicycle routes.
- E-Bicycle specific measures: Those measures include homogeneous standards of production to guarantee a high quality of e-bikes and to prohibit manipulation concerning the driving speed of e-two-wheelers.
- Awareness rising, education and publicity: Awareness rising should be intensified through competent sellers, flyers and brochures for free and trainings offered for (especially elderly) e-cyclists.
- Statistics and further research: There is still further research (e.g. infrastructural needs of e-cyclists, manipulation on e-bikes...) needed. For this reason it is important to have statistical data on the accident occurrences of e-bicycles.

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