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Content

1. Executive summary

In recent years, both the EU and the German government have presented ambitious climate plans that will require a rapid decarbonisation of all sectors of the economy. While this can be accomplished primarily via battery technologies in the passenger car sector, there is a growing need for an electric road system (ERS) to decarbonise heavy goods traffic. A system of this kind, however, must be integrated into the highly regulated existing economic and technical systems – both on the road and in the energy industry – and envisaged in a European context. The establishment of ERS is thus accompanied by considerable political, legal and economic challenges. Tasks such as planning, construction, network operation, toll collection, billing and all mobility services must be assigned by the relevant stakeholders efficiently and in a way that is both technically and economically feasible in accordance with existing law. At the same time, obstacles for transport companies must be removed and incentives created for such companies to use ERS so that the benefits of the new infrastructure are realised, both economically and in terms of climate impact, in a timely manner through a rapid market ramp-up. Although the current legislation already provides a good framework for ERS in some areas, it will not be possible to develop and operate ERS without some adjustment. This paper presents recommendations for important modifications.

A stakeholder model that assigns tasks for the establishment, operation, financing and billing of an ERS for both the market ramp-up and the operational phase is a prerequisite for coherent regulation, for research on economic and societal challenges guided by the legal requirements, and for further technical developments to implement the technology. This position paper therefore presents a stakeholder model with recommendations for its legal implementation that, with few changes to the existing legal framework, is compatible with the existing structures of the relevant stakeholders while allowing for as much competition as possible. According to this model, the ERS infrastructure will be operated as state infrastructure by Autobahn GmbH, constructed as part of the road by the state from the federal budget, and thus financed via a toll. For the benefit of ERS users, a competitive market for electricity with the best tariffs and tariff models is to be created. To achieve this, the roles of the infrastructure operator, the mobility provider and the toll system operator must be separated (unbundling); and, in keeping with the Single Point of Contact (SPoC) concept, the ERS user is issued only one (summarised) invoice in a transparent and uncomplicated manner by a company that, where possible, also handles the legal relationships associated with toll and electricity billing for the ERS user. In this context, it must be taken into account that ERS, like charging points for cars, should not be subject to the network regulation of the energy industry law and thus require their own regulation. Unlike charging points, however, different companies must be able to compete within the ERS for the distribution of traction and charging power; a closer orientation to the electricity market regulation under the energy industry law is therefore logical. For electricity distribution, IKEM proposes a two-stage approach. Since there is currently no meter that complies with calibration law, billing during the market ramp-up can be carried out either by means of a flat-rate model or a connection to the tariff lines of the toll. Once a meter solution that conforms to calibration law is available on the market, billing can be based on kWh; acceptance of different billing types and units should be evaluated during the first test.

2. Introduction

The European Climate Act,[1] presented by the EU Commission on 4 March 2020, and the Climate Protection Plan 2050[2] adopted by the German government set very ambitious targets to mitigate climate change. Meeting these targets requires a significant decarbonisation of all sectors by 2030. It is becoming clear that an extensive integration of electric propulsion systems into heavy goods transport is the best method to reduce GHG emissions efficiently in line with climate targets.[3] Because heavy goods vehicles account for around 25% of total CO2 emissions from road transport,[4] a rapid decarbonisation of this sector is essential. ERS should play a role in this process. For an overview of background information and various technical approaches, please refer to the IKEM Working Paper 'Models for the development of electric road systems in Europe'.

The legal framework at European and German levels does not yet provide for ERS or contain a suitable regulation for the electrification of heavy goods transport by ERS. For a coherent regulation of ERS, only a few crucial adjustments to the existing legal framework are required. Recommendations for the most important adjustments are presented at the end of this paper. However, coherent regulation across all regulatory levels (EU and federal law) and areas (in particular energy and road law) requires a clear understanding of which rights and obligations should fall to which stakeholders. There is thus a need for a viable stakeholder model that can identify the parties responsible for establishing and operating ERS, securing financing for the necessary infrastructure, and ensuring that the billing for user fees is carried out in an efficient and user-friendly manner. This IKEM Working Paper introduces one possible stakeholder model. The regulation proposed at the end of the paper allows for different variants of a stakeholder model that can be implemented according to the needs of the market. The variants presented here should therefore be understood not as different options for regulation, but rather as five methods by which market actors can organise themselves under the proposed regulation. This is not meant to exclude other possible variants that are compatible with this regulation.

Certain preconditions are necessary for the development of a stakeholder model. First, any such model must be integrated into existing legislation, take into account the technical feasibility and framework conditions and align with the existing structures of the relevant stakeholders. The construction and operation of ERS brings together two highly regulated areas – power grid operation and the road sector – which have thus far had few points of contact and involve two separate financing systems (grid fees and tolls). Regulations and directives at European level, and laws and regulations at national level, can be adapted, and certain adjustments will be unavoidable for a robust stakeholder model. However, these adaptations must, in turn, be compatible with the stringent legal requirements of two functioning technical and economic systems currently in place, as well as with standards that take precedence over such requirements (constitution and European treaties). The stakeholder model presented here aims to achieve the following objectives:

- Minimise the need for legal adjustments and the repercussions of proposed adjustments on already established systems in the energy industry and road sector;
- take into account the key regulatory objectives in the energy and road sectors:

One of the objectives of European law is to establish and expand trans-European networks in the areas of transport and energy infrastructure (Article 170 TFEU).[5] This is accompanied by corresponding requirements for the interoperability

1 European Commission (2020): Proposal for a Regulation of the European Parliament and of the Council establishing a framework for achieving climate neutrality and amending Regulation (EU) 2018/1999 (European Climate Change Act), available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020PC0080&from=EN (19.10.2020).

2 BMU (2016): Klimaschutzplan 2050 – Klimaschutzpolitische Grundsätze und Ziele der Bundesregierung, available at: https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Klimaschutz/klimaschutzplan_2050_bf.pdf (19.10.2020).

3 Öko Institut: StratON Endbericht – Bewertung und Einführungsstrategien für oberleitungsgebundene schwere Nutz-fahrzeuge, p. 15.

4 European Parliament and Council (2019): Regulation (EU) 2019/1242, p. 2. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1242&from=EN

5 Treaty on the Functioning of the European Union (TFEU), as amended by the Treaty of Lisbon, which entered into force on 1 December 2009.

of technology and the uniformity of markets, linked to the objective of achieving an internal market (Article 26 TFEU).

In order to achieve the European climate protection goals, the Directive on the deployment of alternative fuels infrastructure (AFID)[6] is intended to create a common framework for measures to develop infrastructure for alternative fuels in the Union (Art. 1). Electricity is an 'alternative fuel' as defined in Art. 2 (1) AFID, and ERS lorries are electric vehicles as defined in Art. 2 (2) AFID. ERS infrastructure has not yet been regulated by the AFID but must be placed in context. Since it should be possible to supply electricity to ERS lorries in the future via two complementary systems, i.e. ERS and charging points, interdependencies in the market regulation of these systems must also be taken into account.

Road law prescribes the administration of federal roads (Art. 90 GG)[7] and their use in public traffic by everyone within the framework of the dedication and the traffic authority regulations for traffic (§ 7 FStrG).[8]

Road traffic law regulates the exercise of public use under regulatory law within the scope of the dedicated purpose.

The Energy Industry Law (Energiewirtschaftsgesetz (EnWG)) aims to provide the general public with a secure, low-priced, consumer-friendly, efficient and environmentally friendly electricity supply that is increasingly based on renewable energies, and to ensure effective and undistorted competition in the supply of electricity. In particular, the law is intended to strengthen the internal electricity market and the free pricing of electricity through competitive market mechanisms (§ 1 EnWG)[9]. The EnWG is largely based on European Community law, which must be fully taken into account.

– Involve current stakeholders in the road and energy sectors, to take into account their existing structures and their assessment of feasibility and efficiency when implementing new structures; and

– remove barriers to the utilisation of ERS by transportation companies, taking into account existing structures, while at the same time creating sufficient incentives for the use of ERS.

The following pages provide an overview of the legal and economic environment with which a future ERS must be compatible. The tasks associated with the financing and accounting processes for an ERS – as well as a possible allocation of these tasks to stakeholders – are then described, and a stakeholder model is proposed for an efficient allocation of the tasks to stakeholders. Finally, selected recommendations for action are presented.

6 Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure.

7 Constitution of the Federal Republic of Germany in the adjusted version published in the Federal Law Gazette Part III, section number 100- 1. Last amended: September 29, 2020 (BGBl. I p. 2048).

8 Federal Highway Act in the version published on June 28, 2007 (BGBl. I p. 1206). Last amended: August 8, 2020 (BGBl. I p. 1795).

9 Energy Industry Act of July 7, 2005 (BGBl. I p. 1970, 3621). Last amended: August 8, 2020 (BGBl. I p. 1818).

3. Stakeholders and tasks

3.1. Prior understanding

The potential stakeholder structure depends on the legal classification of the ERS. Becaues this classification has not been conclusively clarified, the following assumptions are made:[10]

ERS are part of the road:

According to the prevailing expert opinion, at least the physical part of an ERS (distinct from the power grid within the infrastructure) is part of the road on which it is installed. In the three pilot projects in Germany for testing overhead contact line systems for lorries,[11] the ERS were treated as part of the road.[12] In keeping with this opinion, the costs of the ERS infrastructure should be understood as part of the infrastructure costs according to Art. 7b (1) of the infrastructure costs directive (1999/62/EC), which is the basis for the lorry toll levied in Germany. According to Art. 7 (2) of the infrastructure costs directive, this would exclude the levying of an additional user fee for the use of the same road section (e.g. grid fees). If the federal road in question is included in the trans-European transport network (TEN-T), ERS would also be considered a part of this network.

An ERS is an 'alternative fuel infrastructure', but not a charging point. An ERS requires its own regulation in the AFID and the Electricity Market Directive: the AFID and the Electricity Market Directive (EMD-Directive)[13] uniformly define charging points as 'an interface that is capable of charging one electric vehicle at a time'. In this context, charging points are understood as something countable and stationary (cf. Art. 4 AFID). ERS lorries and ERS thus do not appear in the national strategy frameworks for the market development of alternative fuels in the transport sector of the Member States (cf. Art. 3 AFID); the special requirements for stationary charging of lorries at charging points are also not taken into account.[14] A direct or analogous application of the regulation on charging points to ERS would not do justice to their special features and was not envisaged when the directives were issued. Nevertheless, under Art. 2 (1) AFID, electricity is an alternative fuel, for which 'a common framework of measures for the deployment of alternative fuels infrastructure in the Union with 'minimum requirements for the building-up of an alternative fuels infrastructure' (Art. 1 AFID). Because the AFID (supplemented by Art. 33 EMD) aims to provide a common legal framework for the Union for such infrastructure, there is a regulatory gap here.

Exclusion from regulation of electricity supply/distribution networks:

As installations for the supply of energy, ERS are at least energy installations under § 3 No. 15 EnWG and are subject to the EnWG regulations on the grid-based supply of electricity to the general public (cf. §1 (1) EnWG) and the common rules for electricity distribution and supply (cf. Art. 1 EMD) of the EMD. In addition, it would seem self-evident to classify ERS as an electricity supply network (§ 3 No. 16 EnWG)[15] (or part thereof) and, at European level, as a distribution network. However, this classification has been called into question by recent legal developments. For example, the construction and operation of ERSs would be made considerably more difficult and would entail a considerably higher regulatory burden than would the exclusion of ERSs from network regulation. According to the prevailing expert opinion, ERS should therefore be excluded de lege ferenda from network regulation in the EMD and EnWG. ERS should be subject to their own regulation under the AFID, EMD and EnWG, which should take into account their specific features, as is already the case for charging points (cf. § 3 No. 25 EnWG and indirectly Art. 33 EMD). In the three

10 All assumptions concerning the legal dogmatic classification of the ERS will be comprehensively investigated in a doctoral thesis, which is being developed within the AMELIE project. Only the results of the classification are summarised here.

11 These projects include the Elisa – eHighway Hessen, field trial eHighway Schleswig-Holstein (FESH), and the eWayBW.

12 Interview with Dominik Gurske (Hessen Mobil, Road and Traffic Management Department Intelligent Transport Systems Department Cooperative, Interconnected and Automated Mobility, Project: ELISA – eHighway Hessen) on 1 December 2020.

13 Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 concerning common rules for the internal market in electricity and amending Directive 2012/27/EU (Electricity Directive).

14 Cf. for Germany: BMVI: National Strategy Framework on the Development of Alternative Fuels Infrastructure, p. 10f., 14ff., 23ff., 32ff.

15 Hartwig: Energy supply of long-distance road freight traffic via overhead lines, Infrastrukturrecht 2016, p. 2ff.

pilot projects in Germany for testing overhead contact line systems for lorries, ERS were not considered as part of an electricity supply network or as an independent electricity supply network.[16] For the stakeholder model, it is assumed that ERS are outside the scope of network regulation under the EMD and the EnWG, although legal clarification is required on this point. In line with European law, however, it can also be stated that an ERS is not a charging point for electric vehicles (cf. Sections 3 No. 25, 17 (1) EnWG), although it is an energy facility for supplying energy for electric vehicles.

3.2. Tasks

Road construction and ownership:

To make an ERS operational, initial tasks to be performed include planning, construction, operation, maintenance (i.e. also maintenance, repair and setting), financing and asset management of the ERS infrastructure and all related tasks. Within road law, these are referred to as road construction responsibilities. If the ERS is regarded as part of the federal highway, these tasks also fall under road construction responsibilities with respect to the ERS infrastructure. The operation of the ERS as an electrical installation would then also need to be designated a responsibility for road construction. This is to be assessed independently of whether ERS should also be regarded as electricity supply networks/ distribution networks under the EMD and the EnWG, since, in a technical sense, it is unrealistic to divide operational responsibility between two different operators, the party responsible for road construction for the ERS infrastructure, and a network operator for the ERS that is independent of the latter. An ERS is a uniform infrastructure that can only be assigned to one responsible operator. This does not, however, preclude the party responsible for road construction (which is thus also responsible for network operation) from utilising the expertise in electrical operation of the system that is held by companies with experience in the operation of electricity networks and comparable electrical systems. If the ERS is part of the federal highway, the federal government, as the owner of the federal highway, is also the owner of the ERS infrastructure.

Toll collection and billing:

The allocation of funding to the road construction responsibility of the federal government also predetermines the financing of the task through the federal budget, which, in turn, is financed primarily through federal taxes. Further financing contributions from other groups must be placed in the context of this allocation. In Germany, a toll is levied for use by heavy goods vehicles to finance federal highways and essentially all other federal roads relevant to heavy goods traffic. If the ERS is part of the federal highway, its construction, financing, maintenance and operating costs are included in the infrastructure costs according to Art. 7b Para. 1 and Annex III No. 2 of the infrastructure costs directive, and these can be charged to all users of the corresponding federal highways via tolls. One advantage of this model is that the costs of the ERS are allocated to users, as well as to emitters of the GHG emissions that the ERS is intended to reduce, on an equitable basis (kilometres driven) with no further adjustments to the law. Furthermore, since each lorry operator co-finances the ERS through the toll, there is a strong incentive for both domestic and foreign road users to use the ERS.

According to Art. 7 (II) of the infrastructure costs directive, other user fees cannot be levied and offset against the user fees for the use of the same road section. This excludes, in particular, the parallel financing of ERS via network charges or a separate user fee for ERS. Such fees would also exclusively burden ERS users and thus slow down the market ramp-up. If, on the other hand, ERS were regarded as part of the higher-level medium-voltage grid, its costs would be passed on to all downstream grids via the network charges and would thus also burden the household electricity price of households near freeways, for example. A comparable development has already caused resentment in the context of the energy transition (high grid fees for households in regions with high renewable energy generation)[17] and should be avoided for the ERS. The financing of the ERS infras-

16 For Hesse: Interview with Dominik Gurske (Hessen Mobil, Road and Traffic Management Department Intelligent Transport Systems Department Cooperative, Interconnected and Automated Mobility, Project: ELISA - eHighway Hessen) from1. 12. 2020.

17 Deutschlandfunk: Regionale Netzentgelte - Warum der Strompreis vom Wohnort abhängt. Available at: https://www.deutschlandfunk.de/regionale-netzentgelte-warum-der-strompreis-vom-wohnort.697.de.html?dram:article_id=414599. See also Jahn et al.: Netzentgelte 2019 - Zeit für Reformen. 2019, in: Agora Energiewende. Available at: https://static.agora-energiewende.de/fileadmin2/Projekte/2014/transparente-energiewirtschaft/Agora_Netzentgelte_2019.pdf.

tructure exclusively via tolls, as stipulated by law, therefore establishes the proper economic incentives, involves domestic and foreign road users equally in the financing of the ERS and, through the polluter-pays principle, implements a fundamental principle of justice in environmental law with the least possible need for adjustment in regulation and the processes of levy collection. To the extent that ERS users themselves are also appropriately included in the financing of the ERS via an adjusted toll rate for ERS lorries only, this type of financing can therefore also contribute to the acceptance of the system.

The connection to the upstream medium-voltage grid is another cost category for infrastructure expansion that must not be overlooked. The connection of a wide-area ERS will in all likelihood require a considerable expansion of the grid. The entitlement to grid connection under § 17 EnWG, together with the underlying cost mechanism under the EnWG and the StromNEV, means that these costs are in turn passed on to all freeway users via the grid fees, which in turn raises the question of fairness in the distribution of these costs as outlined above. However, such costs can be reduced by setting the construction subsidy at a correspondingly high level. The latter would be included in the ERS construction costs and could thus likewise be included in the route costs and reflected in the toll. The increase in grid fees due to the connection of the ERS to the grid would then likely remain manageable.

All costs that cannot be allocated to the construction, financing, maintenance and operating costs of the ERS as part of the road cannot be included in the infrastructure costs and thus cannot be defrayed by the toll. This applies to the traction and charging power that ERS users receive, the costs of related data processing and communication processes, and other services provided to users in connection with the use of the ERS.

Mobility service and its billing:
The mobility service includes the delivery of power from the ERS grid connection point at the substation to the lorry's current collector. As noted, this service cannot be included in the route costs and funded via the toll. However, the task must also be distinguished from the power supply if ERS are not part of the grid, since the role of the power supplier is reserved for power supply in the grids under the regulations of the EnWG.

Power supply and grid connection:
If the ERS is not part of the power supply grid, it is an electrical installation, which, in turn, requires a connection to the grid at any substation. Furthermore, the mobility service can only be provided if electricity is supplied to the grid connection point of the ERS. Operation of the grid upstream of the ERS, up to the grid connection point and the power supply to it, are subject to the regulations of the EMD and the EnWG. For clarification, it should be noted that, although grid fees cannot be levied in relation to the ERS infrastructure, they are regularly charged in the context of the upstream grids up to the connection point, and are paid to the grid operator by the electricity supplier for use of the grid. They are thus included in the electricity price at the grid transfer point, and the electricity supplier passes on these grid fees to the mobility provider in the electricity bill; the mobility provider, in turn, bills the ERS user for these fees as part of the mobility service.

3.3. Overview of the stakeholders

The most relevant stakeholders for the stakeholder model presented here are based on the identified tasks described above.

Road construction responsibility and ownership:
The Federal Government is the bearer of the road construction responsibility for the federal freeways (Section 5 (1) FStrG) and is their inalienable owner (Article 90 (1) GG, cf. also Section 6 FStrG). To this extent, the planning, construction, operation, maintenance (including servicing), financing and financial management of the federal highways, and thus of the ERS, are the responsibility of Autobahn GmbH des Bundes (§ 1 (1) InfrGG), which in turn is the inalienable property of the Federation (Art. 90 (2) GG, § 1 (2) InfrGG). Any further transfer of the tasks to private parties is ruled out under Article 90 (1) (1) GG and Section 5 (2) InfrGG, and the participation of private parties within the framework of public-private partnerships is severely restricted.

Operation of the ERS as an electrical system:
is also a task assigned to Autobahn GmbH as part of the road construction responsibility. The expertise required to operate such an electrical system (e.g. voltage maintenance, supply reconstruction, electrical operations management and electrical maintenance) is likely limited at Autobahn

GmbH due to its previous range of tasks. If Autobahn GmbH opts not to build up this expertise in-house, it can entrust the construction and operation of the ERS to private companies with experience in grid operation on a section-by-section basis (grid service providers) via a public tender. At the same time, the limited privatisation options in the area of federal highways mean that Autobahn GmbH may only use the network service provider to fulfil the task as an administrative assistant and that the latter does not itself appear as the operator of the ERS (functional privatisation). Thus, the operation of the power grid is materially in the hands of Autobahn GmbH, which can, however, make use of different operating companies according to grid sections. At the same time, this means that the ERS is a uniform federal ERS throughout Germany, and users generally will not notice that different network service providers take on operating tasks in different sections. However, a significant restriction on the involvement of private expertise by way of functional privatisation currently arises from Section 5 (2) (3) InfrGG, which limits the involvement of private parties in the planning, construction, operation and maintenance of federal freeways or other federal trunk roads to individual projects with a total scope of up to 100 kilometres. This is probably too short for meaningful operation. As a result, a special regulation regarding the allocation of ERS operation should be considered, for example through an extension of the sections.

Toll collection and billing:

Another stakeholder is the toll system operator. In Germany, this is the federally owned Toll Collect GmbH, which is responsible for billing the transport companies for the toll. If the costs of the ERS are included in the road cost accounting, they are covered by this toll. Toll payment is automatically monitored, and additional charges are levied if tolls are not paid; these mechanisms, including enforcement, already exist and function without the need for separate regulations. Two legal relationships must be distinguished in toll collection.

On the one hand, there is a public-law toll debt relationship, in accordance with BFstrStMG, between the Federal Republic of Germany and the party incurring the toll. On the other hand, there is a contractual relationship under private law, in accordance with Section 662 of the German Civil Code (BGB), between the national toll system operator and the ERS user incurring the toll.

By using the toll collection system, the party incurring the toll instructs Toll Collect GmbH, pursuant to Section 662 of the German Civil Code (BGB), to extinguish the public-law toll debtor relationship between it and the Federal Republic of Germany (Federal Government).[18]

18 Walter, Die Lkw-Maut in Deutschland, Schriften zum Öffentlichen Recht, vol. 1225 (2012).

Excursus: Partial toll exemption

It is important to note that electric vehicles do not currently pay tolls pursuant to Section 1 (2) (7) BFStrMG. On the one hand, this poses a technical problem: in order to keep the use of ERS as simple as possible for users, the processing of all necessary contractual relationships as well as the invoicing for all services should be carried out by a single source (single point of contact). From a technical point of view, the plan is therefore for all data required for toll and electricity billing to be recorded by the on-board unit (OBU) already present in lorries, especially because space in the lorries is limited and there is an interest in avoiding further technical terminals in the vehicle (single device). However, lorries that do not have to pay tolls generally do not have an OBU. In addition, a complete toll exemption for ERS lorries is not appropriate, as they should at least partially contribute to the financing of ERS via the toll for reasons of fairness of the levy. Excluding ERS lorries from financing the ERS infrastructure built for their benefit could be perceived as unjust by other road users. In addition, e-trucks that can only charge at charging stations also co-finance 'their' infrastructure through the charging electricity price there, which must price in the cost of the charging infrastructure. With regard to a toll reduction and other subsidies for ERS lorries to ensure a rapid market ramp-up for the timely implementation of ecological objectives, an optimal balance must be sought between the burden on the state budget and the subsidy-dependent economic attractiveness of an ERS. Low operating costs can provide a significant incentive for the use of ERS through (partial) toll exemptions and electricity cost reductions. However, this requires ERS to be included in Section 9(2) of the Electricity Tax Act. This incentive can also be strengthened if transport is included in the mechanisms for pricing CO2 emissions. The initially higher initial investment for ERS lorries can best be offset by subsidy credits. Whether purchase premiums are also required as additional instruments must be calculated in the precise design of the subsidy strategy. Toll reductions for ERS lorries can already significantly accelerate the market ramp-up.[19]

A complete toll exemption, on the other hand, is not necessary for a rapid market ramp-up and would result in excessive shortfalls in toll revenues with corresponding consequences for the federal budget if the number of users were to increase rapidly.[20] An initially high, transparently planned, well communicated and degressively decreasing subsidy with the above-mentioned instruments can provide targeted incentives for a rapid market ramp-up and at the same time keep the burden on the federal budget within limits and easily controllable. It therefore seems advisable to create a separate toll class for ERS lorries in Annex 1, No. 1 BFStrMG[21], itself subdivided according to the weight classes also provided for other vehicles. In this context, it would be obvious to provide in Section 1 (2) BFStrMG that ERS lorries pay the partial toll rate for infrastructure costs according to their class, but continue to be exempt from the partial toll rates for the air pollution costs caused and the noise pollution costs caused, at least to the extent that, as purely electric vehicles, they contribute significantly less to air pollution (depending on the electricity mix) and noise pollution than conventional lorries. The partial toll rate for infrastructure costs, on the other hand, should be levied, but initially at a much lower rate than the rates for other vehicle classes (incentive effect). It could then gradually increase with successful market ramp-up. Since an additional part of the road (the ERS) can only be used by ERS lorries, this partial toll rate could later even be higher than the partial toll rate for vehicles of a comparable emission class. Here, a balancing with the funding policy objectives and the funding concept is also required with regard to other alternative drives, fuels and their infrastructure.

In this context, it should also be pointed out that § 2–4 EMoG and all regulations based on it (StVG, StVO, laws of the federal states that provide privileges for electric cars, etc.) currently apparently only correctly address electric cars. Some of these regulations also apply to electric lorries, but these were obviously not included in the conception of the law. For example, the pollutant values provided for in § 3 (2)

19 Institut für Energie- und Umweltforschung (IFEU): Roadmap OH-Lkw: Einführungsszenarien 2020-2030. Optimierung des Infrastrukturaufbaus für O-Lkw und Analyse von Kosten und Umwelteffekten in der Einführungsphase. 2020, p.55ff.

20 Öko-Institut: StratON - Bewertung und Einführungsstrategien für oberleitungsgebundene schwere Nutzfahrzeuge. Final report, p.178f.

21 Federal Highway Toll Act of July 12, 2011 (BGBl. I p. 1378). Last amended: Article 5 of the Act of June 29, 2020 (BGBl. I p. 1528).

are hardly suitable for hybrid lorries. Since the EMoG is the starting point for the preferential treatment of electric vehicles and their labelling, clarity should be created here. This opportunity could also be used to consider the introduction of specific labelling for ERS lorries, as such labeling would also make it easier to identify misuse of the ERS and simplify the faster initiation of countermeasures by the authorities.

Mobility service and billing:

According to the stakeholder model presented here, ERS is a monopoly infrastructure. The fact that the operator of an ERS infrastructure is without competitors for the relevant geographic market (cf. Section 18 (1) (1) ARC[22]) is already clear from the technical circumstances: there will only be one ERS on a section of motorway at any one time; in the moment that a concrete decision is made to use an ERS, the ERS user cannot therefore choose between different ERS systems. In order to avoid excessive monopoly prices, there are only two options for market design: price regulation or the creation of a competitive market for driving and charging power by unbundling the mobility service and its billing from the infrastructure operation. Art. 1 EMD and § 1 (2) EnWG reveal a preference for competitive electricity markets. Such competition for the lowest electricity prices, the best service and suitable tariff models can be achieved through unbundling and independent regulation of the mobility provider.

In practice, it is likely that the role of mobility provider will generally be carried out by a power supplier. The separation of the roles is therefore appropriate, since the ERS is exempt from the grid regulation of EMD and EnWG. In this context, it will probably even be necessary to extend the obligations of an electricity supplier under sections 40 and 42 EnWG (electricity billing, electricity labelling and transparency of electricity bills) to mobility service providers as well. However, some of the provisions of sections 36 ff. EnWG (e.g. on basic and substitute supply) would have to be regulated differently. In addition, it is conceivable that other market players (e.g. European Electronic Toll Service providers, so-called EETS providers) could assume the role of mobility providers without actually being power suppliers. This could also be attractive because EETS providers make their own OBUs available to their customers. A company that is both an EETS provider and a mobility provider could thus manage all billing-relevant data for both toll and electricity billing and thus expand its role as a Europe-wide service provider for all toll-road-related billing services.

In the authors' opinion, an unbundling of the roles of the mobility provider from the toll system operator should also be considered, as the latter could presumably gain a competitive advantage through the existing business relationship with all potential ERS users. However, whether the role of mobility provider is economically attractive for a toll system operator cannot be assessed within the scope of this paper. If further studies prove otherwise, there is also no need for a corresponding regulation on unbundling.

Billing service provider, EETS provider and European Electronic Mobility Service (EEMS):

For the smoothest possible handling of all contractual relationships and billing processes vis-à-vis the ERS user by an SPoC, it should also be taken into account that there are already billing service providers in the transport sector that could presumably easily take over such a service for electricity billing as well, without intending to become mobility providers themselves. Such (national) billing service providers currently often appear primarily as providers of fuel cards that simultaneously process all payments to the toll system operator as a toll service (OBU operation by the toll system operator) and offer various other services for processing toll payments (e.g. posting of routes, invoice verification). In addition, such companies often also handle the contracts and billing for vehicle cleaning and repair needs at partner companies and offer extensive support for customs clearance and cost management in combined transport. If freight forwarders are used to paying their tolls via such a billing service anyway, it is probably also obvious to them

22 Act against Restraints of Competition (GWB) as amended by the announcement of June 26, 2013, BGBl. I pp. 1750, 3245.

not to bother with a mobility service provider, but to choose contract processing and billing via their billing service provider here as well. The possibility of cooperating with different mobility providers even makes it possible to arrange power supplies from different mobility providers (e.g. depending on the route), since the system can switch providers at any time. This does not require any further regulation but underscores that the proposed billing system can fit into the existing stakeholder structure with relatively few legal adjustments and without overburdening stakeholders or transport operators.

At European level, the role of the billing service provider has been harmonised in the form of the EETS provider. The European Electronic Toll Service (EETS) establishes a settlement service provider that is registered and approved by the BAG[23] to ensure the interoperability of electronic toll systems in the EU. Directive 2004/52/EC on the interoperability of electronic road toll systems in the Community (EETSD) provides a European legal framework for 'electronic collection of all types of road fees, on the entire Community road network, urban and interurban, motorways, major and minor roads, and various structures such as tunnels, bridges and ferries' (Art. 1 EETSD). EETS operators 'shall make available to interested users on-board equipment which is suitable for use with all electronic toll systems in service in the Member States […] in all types of vehicles', which 'shall at least be interoperable and capable of communicating with all the systems operating in the Member States using one or more of the technologies listed in paragraph 1' (Art. 2 EETSD), using specifications that are made publicly available (Art.4 EETSD). Thus, with an OBU and a contract with an EETS operator, it is possible to use the toll service for the entire network (Art. 3 EETSD). Combining this role with that of a harmonised pan-European mobility service opens up the possibility of a pan-European SPoC for ERS users, allowing them to use ERS and electronic toll systems across Europe with the lowest possible transaction costs. It would be most beneficial to place a European Electronic Mobility Service (EEMS) alongside the European Electronic Toll Service (EETS) and to regulate them jointly. In order to limit the independent regulation of the mobility provider at European level, exploit the synergies by performing both tasks and realise the EETSD objective of intermodal systems (Recital 11) and a single contract between customers and service providing operators (Recital 13a), EETS and EEMS customers could have a single billing service provider for all European ERSs for both toll and electricity billing (to the extent that the respective Member State participates in EETS and EEMS). In this case, an EETS Provider would not have to act as a mobility provider but could merely broker the services of a mobility provider in a manner comparable to a billing service provider (EETS-EEMS Provider).

Participation in EETS is not mandatory, and a conventional billing service provider is also sufficient for purely national ERS traffic, ensuring both toll processing and contract processing and billing vis-à-vis a mobility provider. The national toll system operator can also represent the SPoC here.

Other stakeholders:

The stakeholder model presented also results in an expansion of the tasks of other stakeholders, such as the operators of the upstream power supply networks, power suppliers up to the substation, and other authorities involved in toll processing and supervision (BAG, FBA). For example, the ERS operator has a right of connection to the upstream power supply grid, and the supervision of the BAG and FBA now extends to the ERS. However, there is a need for regulation only with regard to the above-mentioned stakeholders, which are therefore the only ones addressed in detail in this paper.

23 The Federal Office for Goods Transport (BAG) is an independent higher federal authority in the portfolio of the Federal Ministry of Transport and Digital Infrastructure (BMVI) and fulfils a variety of tasks in the field of road haulage and passenger transport, in particular control and punishment tasks according to the Road Haulage Act (GüKG) and BFStrMG. Among other things, it is responsible for the registration and approval of EETS providers in accordance with §§ 4ff. MautSysG (Toll System Act of 5. 12. 2014 (BGBl. I p. 1980), last amended by Act of 20 November 2019 (BGBl. I p. 1626)).

4. Stakeholder model

4.1. State ERS infrastructure as a market for mobility services

The description of the stakeholders and their tasks results in a stakeholder model for the introduction of an ERS, for which a regulatory proposal will be made at the end of this paper. For the stakeholder model, it is assumed that, in a market ramp-up phase, a core network of an ERS is established by the federal government, but that only a few lorries initially use this ERS. Ultimately, however, it serves as a kind of blueprint that outlines the distribution of tasks and key stakeholder relationships after the market ramp-up is complete. However, some tasks may be performed by different stakeholders in this model and in accordance with the regulatory approach derived from it. The different variants presented below are derived from this and are intended to illustrate the flexibility of the chosen regulatory approach. Which variants prevail must be left to the market. All variants can exist side by side, provided that individual stakeholders recognise one of the constellations offered here as being most compatible with their existing business model and wish to perform the tasks mentioned in this form. However, the European variant presented here can only be implemented if the European institutions adopt the regulatory approach proposed below. At the end of the position paper, an alternative scenario is presented to show how the stakeholder model presented can also be implemented nationally (i.e. through federal regulation alone). In this case, only the three national variants of the stakeholder model presented can be implemented with the regulatory approach proposed there.

First and foremost, the European variant for the introduction of the ERS will be presented here. This would enable a Europe-wide SPoC with a uniform OBU and would entail low transaction costs for cross-border traffic compared with national variants. It is therefore considered the preferred solution.

In all variants, it was assumed that it would be preferable for ERS users to handle their toll obligation and mobility service contract through an SPoC. In this case, the costs of infrastructure use (toll) would be shown on the same invoice as the electricity purchase (including the services associated with billing), but as clearly separate cost items, since the toll is a charge (public-law levy) and the payment for the traction and charging power is a fee (private-law consideration). For reasons of competition law, it is necessary to separate the roles of the mobility provider and the ERS operator (in Germany, Autobahn GmbH des Bundes). Separation of the roles of the mobility provider and national toll system operator can also be considered. This is based on the idea that the toll system operator has an advantageous position. After all, it has the data required for the collection of the toll. In addition, the operator would automatically have an SPoC if it sold traction power and collected the toll at the same time, which would provide the toll system operator with have an initial market advantage. However, this strong market role is qualified by the fact that national toll system operators are already competing with a majority of EETS providers. In addition, EETS providers enjoy a number of advantages. Toll Collect GmbH, for example, has an obligation to provide a basic service. EETS providers, on the other hand, can

Figure 1: Legend explaining the fields of action in ERS. Source: Own representation..

select their customers. For example, they have the option of returning so-called kickbacks (e.g. 1–2% of revenues) to the toll payers.[24] It may therefore be sufficient to regulate data availability and transfer by the national toll system operator and to dispense with so-called unbundling between the toll system operator and mobility provider.

To ensure that ERS users nevertheless interact with only one stakeholder who handles the contractual services for them, both the toll system operator and the mobility provider can assume the role of the SPoC if the roles are separated. Alternatively, ERS users may use a billing service provider to handle both the toll and the mobility service contract with the corresponding billing on their behalf. A variant in which two different stakeholders (e.g. EETS provider for the infrastructure costs and mobility service provider for the mobility service or mobility power) settle accounts with the ERS users is likely to find lower acceptance due to the increased effort on the part of the hauliers; as a result, this model has not been investigated. Nevertheless, the respective freight forwarders are responsible for arranging their toll relationship directly with the toll system operator, for finding a separate mobility provider for the supply of power, and for obtaining a separate invoice for the traction and charging power from the provider.

In all stakeholder model variants for the introduction of an ERS presented below, various symbols are used to symbolise the tasks that assign different areas of responsibility to stakeholders. These are listed as a legend in Figure 1.

24 Interview with Marco Zedler (Toll Collect GmbH) from 10.02.2021.

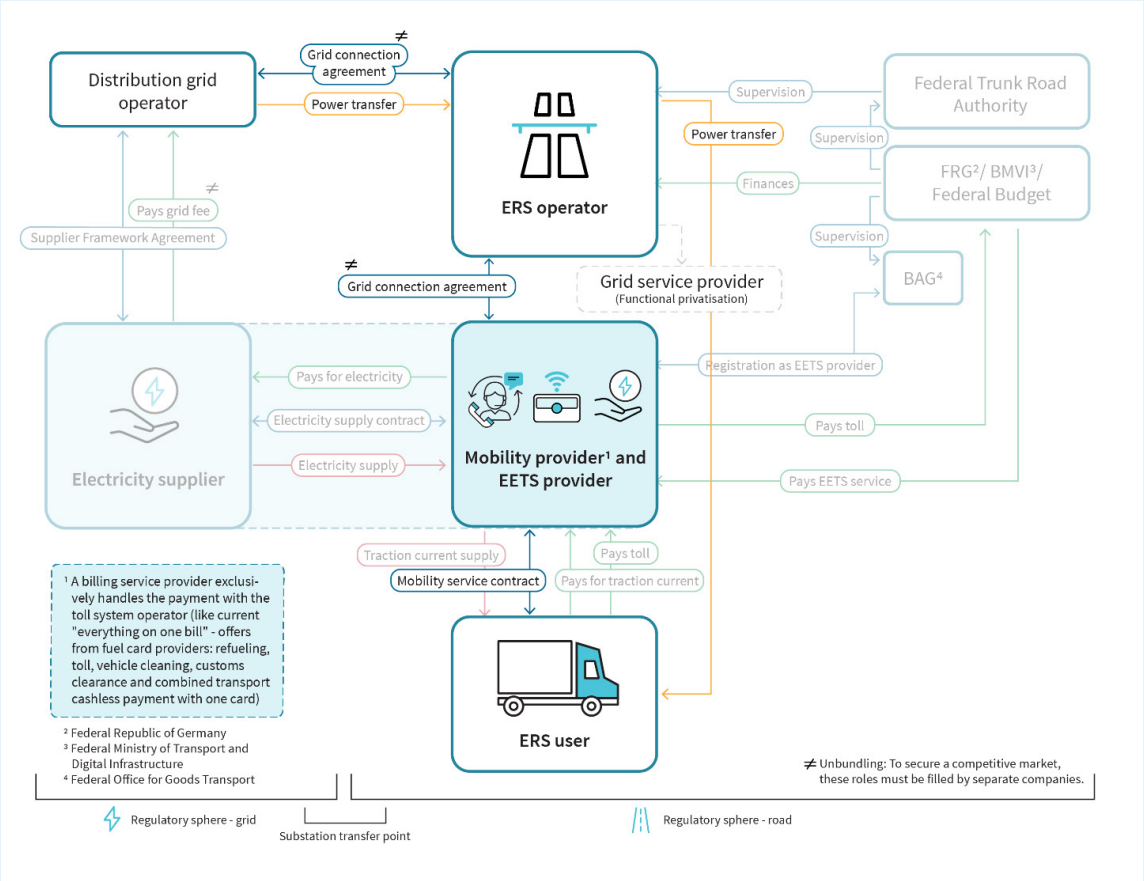

Figure 2: Representation of physical electricity flow in the ERS. Source: Own representation.

The representations of the stakeholder models aim to provide an overview of the necessary contractual relationships between the stakeholders in the different variants. It is also important to note that the physical flow of electricity is always established via the DSO to the ERS operator (i.e. the traction power network) to the ERS user. Separate from this is the balancing supply, i.e. the sale of electricity from the power supplier via the mobility provider to the ERS user. Thus, the physical and the economic value chain differ in this point. The ERS operator receives a share of the toll to pay for its expenses, since the ERS is understood as part of the road. This procedure largely corresponds to the procedure in the electricity sector, whereby the electricity supplier is responsible for the accounting of the end customers, while the network operator is responsible for the physical supply. This is illustrated in the following figure.

European Variant 1:

The ERS user settles tolls and electricity via an EETS/EEMS provider. A usage contract for the ERS infrastructure exists between the mobility provider and the ERS operator, which is essentially a technical usage contract, since no charges are incurred in this relationship. The mobility provider has a mobility service contract with the ERS user, which regulates the delivery of the traction and charging power in exchange for payment. The SPoC of the ERS user, however, is the EETS/EEMS provider, which handles both contract collection and billing vis-à-vis the mobility provider, pays the toll to the toll system operator and bundles all related processes. In Germany, the toll system operator is supervised by the BAG, which is subordinate to other ministries. Moreover, there is no need for unbundling between the mobility provider and the electricity supplier; in practice, mobility providers will often also be the established electricity suppliers, which merely act in a different role (namely, in the German case, outside the regulatory scope of the EnWG) by supplying traction power via the ERS. In a figurative sense, the ERS user will thus be able to 'take along' the electricity supplier (in a slightly modified role) through all European ERSs. It is also not necessary to unbundle the EETS provider and the mobility provider, so that the EETS provider can also offer mobility services from its own company and would thus be an EEMS provider in

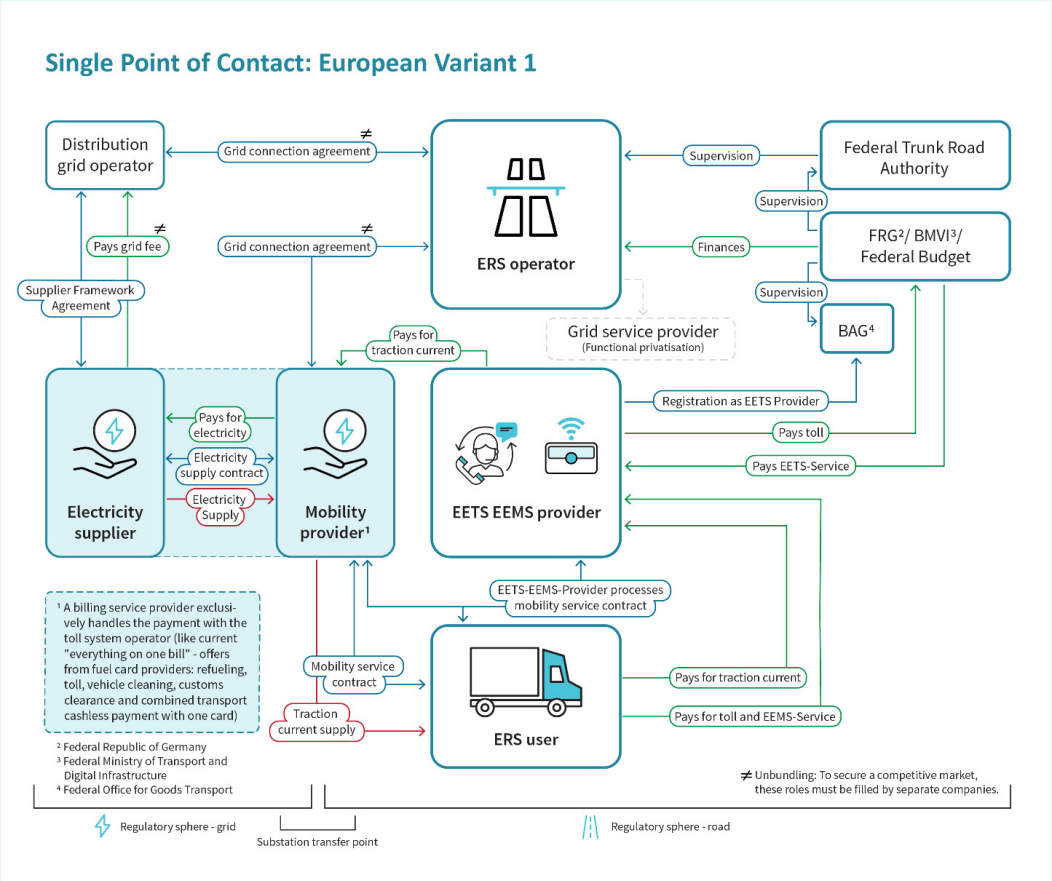

Figure 3: European variant 1 for the introduction of an ERS. Source: Own representation.

its own right (Europe-wide offer of mobility power and its billing to its customers). If the roles of EETS provider and EEMS provider are coordinated and regulated at European level, a company that performs both roles with its OBU can also provide all the necessary data services for its customers Europe-wide. In this process, the EETS providers collect the toll and settle it with their customers. They then pay the toll (without the involvement of the national toll system operator) to the federal government (federal treasury). The reports and data records on the toll-paying journeys go directly to the Federal Office for Freight Transport.

In contrast, freight forwarders that primarily operate nationally do not generally use the service of an EETS provider and operate with an OBU from the toll system operator. For this reason, three national variants of billing with an SPoC will be presented below. It should be noted that this is the same stakeholder model under the same regulation, except that there are different variants as to which stakeholders perform which tasks. It is left to the market to decide which variants will prevail and to ERS users to choose one of the variants for themselves in accordance with the market.

European Variant 2:

In this variant, a mobility provider decides to take on the role of an EETS provider at the same time, with the advantage of also being able to be the ERS user's SPoC throughout Europe and, as an OBU operator, to receive the data on electricity billing and toll collection directly. The ERS user therefore enters into a contract with the mobility provider and initially pays for the traction and charging power as well as the toll to the provider. The mobility provider then provides payment for any electricity costs to the electricity supplier and the toll to the federal government. Apart from this, this variant is identical to the European Variant 1.

The following national variants are a possible market organisation under the European regulatory framework proposed here. The main difference from the European billing variants is that, as a rule, national billing service providers (without their own OBU), rather than EETS providers, are used for

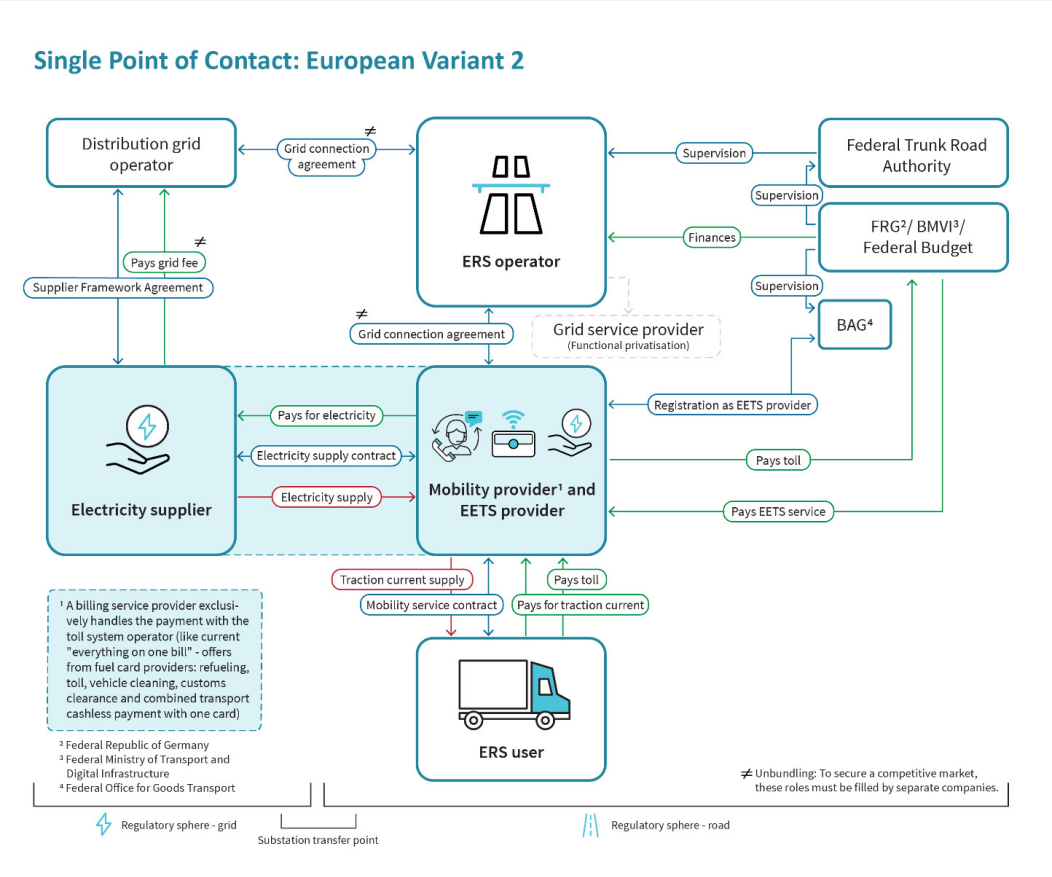

Figure 4: European variant 2 for the introduction of an ERS. Source: Own representation.

toll billing in the national framework, or the toll relationship is handled directly with the toll system operator. If a European variant for the introduction of ERS does not come about, the following national variants of billing can, however, be established uniformly through national regulation.

National Variant 1:

Here, too, the ERS user settles the electricity and the toll via a mobility provider. Here, the tasks of the European EETS provider are taken over by a national billing service provider, as can be seen in Figure 4. A key difference is that the billing service provider does not operate an OBU and receives its toll billing data from the toll system operator. In this variant, the data required for electricity billing would also first be collected by the toll system operator and then passed on to the mobility provider/billing service provider to the extent required to process the contract. (For more details on data processing, see 4.4). Toll payments flow into the federal budget via the BAG. The Federal Republic of Germany has commissioned Toll Collect GmbH to collect the toll. If ERS users use the toll system, they thus instruct Toll Collect GmbH to pay the toll rate determined. This terminates the public-law obligation or charging relationship (toll as a public-law user fee) between the ERS user and the Federal Republic of Germany.[25]

National Variant 2:

At the national level, it is also conceivable that the ERS user would use an independent billing service provider who would merely process the contract with a mobility provider on their behalf and, if desired, also act as an intermediary. In the same way that fuel card providers currently enter into

25 2.1 der AGB der Toll Collect GmbH, abrufbar unter: https://www.toll-collect.de/de/toll_collect/AGB.html (26.02.2021).

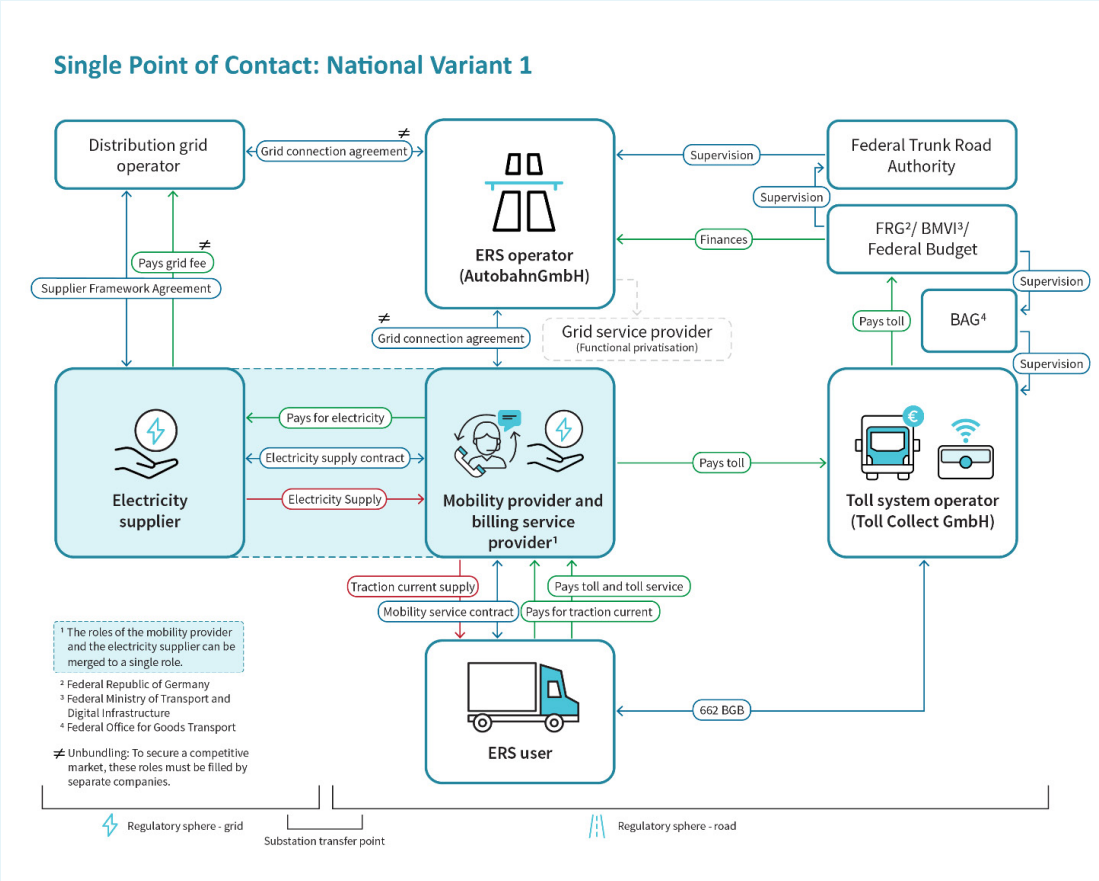

Figure 5: National variant 1 for the introduction of an ERS. Source: Own representation.

contracts with service station operators, this variant would allow billing service providers to enter into contractual relationships with one or more mobility providers and handle the mobility service for their customers without having to supply traction and charging power themselves. This option may also be suitable for electricity suppliers who wish to act as mobility providers and sell charging power to ERS users without also offering toll services. In this case, an electricity supplier would only have to make minor changes to its business to sell electricity via ERS, as only details of the obligations of electricity suppliers and mobility suppliers would differ under the regulation proposed here.

National Variant 3:

In this variant, the toll system operator represents the SPoC. The ERS user receives an invoice for the toll from the national toll system operator (in Germany, Toll Collect GmbH). This also contains the electricity costs that the mobility provider invoices via the toll system operator. However, there is nothing to prevent the toll system operator from handling (mediating) the billing for the mobility provider, provided it is clear at all times that the mobility service is provided by the latter and the billing is done in its name. ERS users must also be expressly informed that they can change the mobility provider at any time and that this provider is not identical to the toll system operator. If the toll system operator mediates the contract with the mobility provider, all mobility providers on the market must be given equal access; none can be disadvantaged or receive preferential treatment. This applies in particular in the event that the toll system provider also acts as a mobility service provider. In other words, the toll system operator must act in a competitively neutral manner and must not use its market power to establish a monopoly or oligopoly market with one or a few mobility providers. If this variant is of interest to the stakeholders, the role of the toll system operator would need to be regulated under competition law.

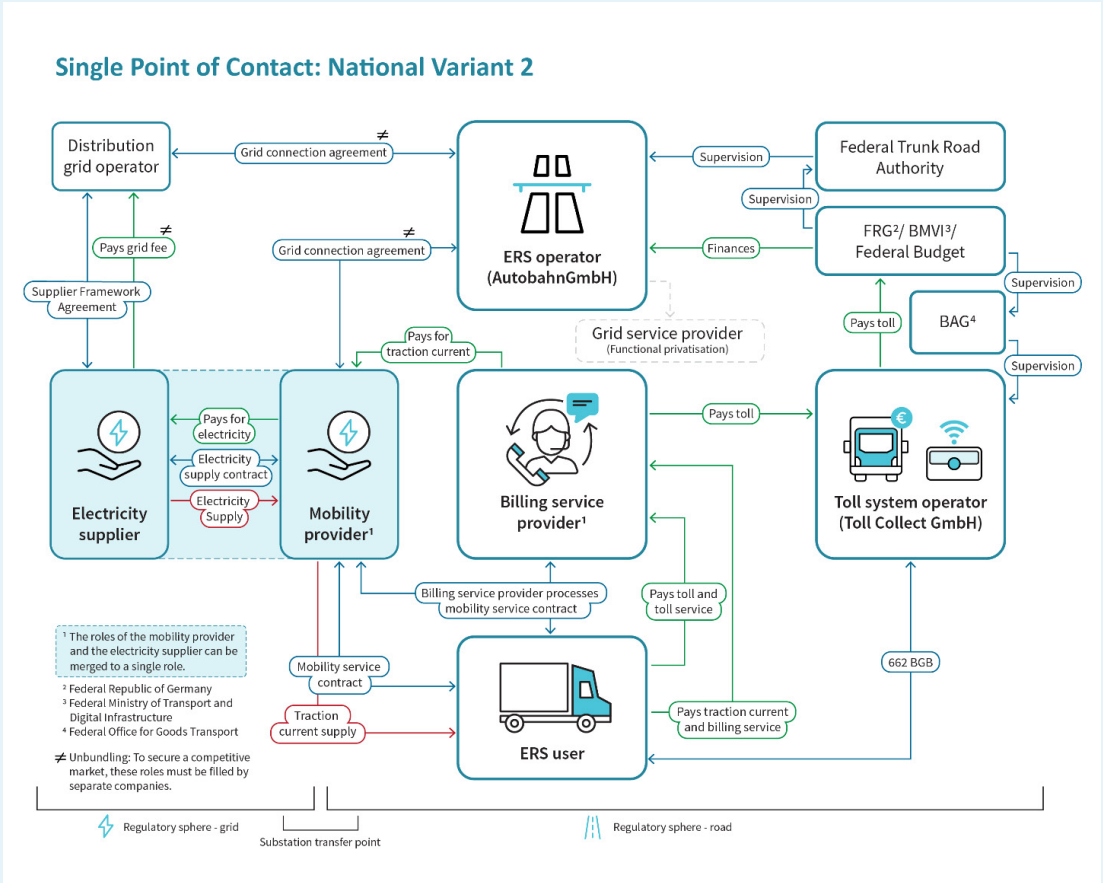

Figure 6: National variant 2 for the introduction of an ERS. Source: Own representation.

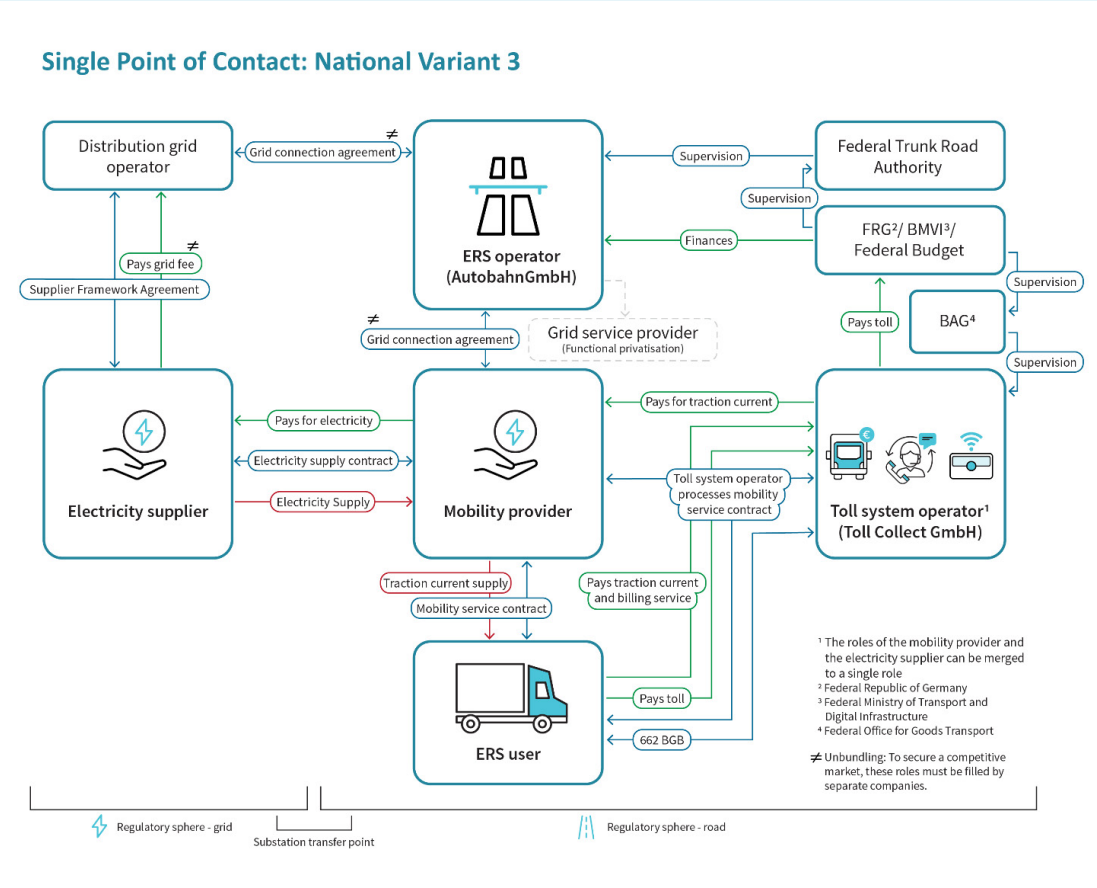

Figure 7: National variant 3 for the introduction of an ERS. Source: Own representation.

4.2. Variants for billing the electricity consumed while driving

There are several conceivable ways of billing for traction power. While billing according to kWh as a precise and consumption-based form of billing is a possible variant, billing according to distance travelled and tariff routes, as well as flat-rate approaches in the sense of flat rates, are also possible. Their advantages and disadvantages, as well as their implications for data protection issues, will be described below.

4.2.1. Billing according to kilowatt hours (kWh) drawn:

In most contracts for the supply of electricity, electricity is billed on the basis of the kWh consumed. In Germany, the Price Indication Ordinance (Preisangabenverordnung) stipulates that consumers are billed on the basis of the kWh consumed.[26] Therefore, charging power at publicly accessible charging points for electric vehicles is also billed per kWh.[27] The use of an ERS for heavy goods traffic by consumers can essentially be ruled out, which makes the Price Indication Ordinance inapplicable; the unit of billing could thus be left to private autonomy when concluding the mobility service

26 Cf. Art. 4 (10) AFID and Sec. 3 Sentence 2 Price Indication Ordinance in the version of 18. 10. 2002 (BGBl. I p. 4197). Last amended: 17.07.2017 (BGBl. I p. 2394). A.a.: Mühe/De Wyl: Rechtliche Rahmenbedingungen für die Abrechnung des Ladens von Elektrofahrzeugen, in: EnWZ 2018, 339 (344).

27 BMWi: Legal Opinion on the Applicability of Section 3 of the Price Indication Ordinance (PAngV) to Charging Power for Electric Vehicles and on the Admissibility and Compatibility of Various Tariff Models for Charging Power on the Market with the Requirements of the PAngV (2018), available at: https://www.bmwi.de/Redaktion/DE/Downloads/P-R/preisangabe-fuer-und-abrechnung-von-ladestrom-fuer-elektromobile-rechtsgutachten.pdf?__blob=publicationFile&v=11 (08.12.2020).

contract, taking into account the requirements of measurement and calibration law. However, billing electricity according to kWh appears to be the most compatible with European regulation of measurement, calibration and billing; as a result, billing ERS users for traction and charging power according to kWh also seems logical. The European definition of uniform units, requirements for measuring devices, interfaces for data transmission and data formats would be preferable for European interoperability of the ERS.

According to § 31 MessEG[28] in conjunction with § 1 (1) (6) MessEV,[29] all measured quantities in the supply of electricity, i.e. in particular the measurement of kWh, are subject to calibration. Since there may be different tariffs in different grid sections, the position of the vehicle (place marker) and the time of withdrawal must also be recorded via a time marker and stored together with the measurement data in the back end. Compared to other billing units (time, km), the kWh as a billing unit offers the advantage of consumption-based electricity billing and thus also an incentive to minimise electricity consumption. This can be particularly relevant for different vehicle sizes and technical specifications, since the amount of electricity consumed varies accordingly and, as a result, some consumers would be disadvantaged or advantaged if other billing units were used. Accordingly, a consumption-based solution could also contribute to increased acceptance of the billing form. It is also in line with the ecological objective of minimising GHG emissions, since consumption-based metering creates greater incentives for efficiency for vehicle manufacturers and operators. In addition, the billing form is also suitable for a European context, since the European price directive[30] (applicable only in the C2B) stipulates that only one other unit of measure can be used for a specific product; and for the EU electricity meter, too, only the kWh is intended as the billing unit.[31]

However, there is currently no DC meter that complies with calibration regulations and meets the high requirements for long-term use in lorries.[32] The vibration on the lorries, the small installation space in the lorry, which requires a small meter size, and the high frequency of the measurement required for legal metrology reasons, as well as the requirements for data transmission and legally compliant storage in the back end, are challenges for the development that preclude the use of meters for railroad applications, for example.[33] Companies that could be considered for such a development expect high development costs and do not wish to start with a corresponding development until a relevant market for such meters emerges.[34] This results in a chicken-and-egg problem: without a meter, there will be no calibration-compliant billing per kWh for ERS, and without an initial market ramp-up, there will be no calibration-compliant meter.[35] However, once the development of such a device is complete, this form of billing can be considered generally advantageous over other forms of billing. For the market ramp-up phase, however, another billing option must be found until a suitable custody transfer compliant meter is available on the market.

4.2.2. Other billing options

Thus, for the market ramp-up phase, another billing option must be found. In addition, this phase can be used to evaluate different settlement options. In particular, if no European solution for the introduction of ERS can be found at first, settlement on the basis of another unit could prove so advantageous during this phase that it is continued afterwards.

28 Measurement and Calibration Act of July 25, 2013 (BGBl. I p. 2722, 2723). Last amended: Article 87 of the Act of November 20, 2019 by (BGBl. I p. 1626).

29 Measurement and Calibration Ordinance of December 11, 2014 (BGBl. I p. 2010, 2011). Last amended: Article 12b of the Act of April 28, 2020 (BGBl. I p. 960).

30 Directive 98/6/EC of the European Parliament and of the Council of 16 February 1998 on consumer protection in the indication of the prices of products offered to consumers, OJ L 080, 18/03/1998 p. 0027 - 0031, Recital 8, Art. 2 lit. b).

31 Directive 76/891/EEC of 4 November 1976 on the approximation of the laws of the Member States relating to electricity meters, Annex Chap. 1 No. 2.6, p. 2.

32 Interview mit Werner Pfliegl (Siemens Mobility GmbH, Leitender Produktmanager, Projekt AMELIE) vom 23.11.2020.

33 Ibid.

34 Ibid.

35 Ibid.

4.2.2.1. Kilometres

It would be possible to bill according to kilometres travelled. This would require a calibrated odometer and electronic recording of the condition of the current collector to determine whether it is connected or disconnected. This makes it possible to determine with legal certainty how many kilometres the ERS vehicle has travelled on an electrified highway section. A taximeter for lorries that conforms to measurement and calibration law is not currently available. On the other hand, it is not possible to accurately account for the traction power used. A combination of distance travelled and vehicle type is therefore unsuitable as a representation of electricity consumption. It remains unclear how much electricity was actually used and there is no incentive for energy efficiency. Better containment would be conceivable by billing the lorries according to weight classes. However, if billing is to be based on kWh anyway after an initial market ramp-up phase, the development of a calibration-compliant taximeter with the definition of weight classes as a transitional solution is likely to be too costly.

4.2.2.2. Tariff route

In addition, a flat rate can be charged per kilometre according to the tariff route, which the toll system operator also uses as a basis for toll billing. In this case, a tariff route is defined by two consecutive junctions that a lorry must pass through once it has started. The officially measured length of the tariff route, the names and coordinates of the junctions are listed in the BAG's toll table. Each tariff route is fully billed according to its length as soon as the lorry has connected to the ERS at least once. In addition, on the vehicle side, there must be an electronic record of whether the lorry connected its pantograph to the ERS in the respective section of the route. This information would be stored in conjunction with a time stamp. Furthermore, the vehicles would need to be divided into weight classes for billing purposes, so that an average electricity consumption on a tariff route could be determined for this weight class and billed in full. Calibrated measuring devices are not required, since no measured quantities are to be determined when electricity is supplied. Billing is not as accurate as, for example, by kWh, and therefore does not incentivise energy efficiency. One advantage of this solution is that it incurs low costs for the ERS operator and the ERS user, since calibrated meters do not have to be installed, operated and, if necessary, recalibrated; the accruing data are also lower and their storage in the back-end does not have to comply with the stringent requirements of calibration law. At the same time, the billing of the toll on the basis of the officially measured tariff route is already established and accepted, which makes it likely that there will be sufficient confidence in this billing basis and thus acceptance by the users. Because it combines a familiar billing basis with a relatively simple and inexpensive billing mechanism that can be introduced immediately, billing according to tariff routes is particularly suitable for the market ramp-up, since electricity can be reliably billed from the first commissioning of ERS. In addition, this type of billing creates an additional incentive for the electricity consumer to maintain a connection to the ERS as continuously as possible, since the flat-rate electricity price for a tariff route is already billed when there is one-time contact between the electricity consumer and the ERS infrastructure in the respective section.

4.2.2.3. Time

Furthermore, time-based billing is possible. This requires a conformity-assessed time meter as an individual device. Billing is independent of the actual amount of electrical power drawn by the respective ERS user. This varies depending on the vehicle type and technical specifications of the charging equipment (overhead line, conductor rail) without these differences being reflected in the usage billing. Consequently, time is not a clear equivalent for the amount of charging power drawn and, again, a suitable meter would first have to be developed and installed on the lorry.

Time is not one of the measurands defined under Section 1 (1) of the German Measurement Act (MessEG) and is therefore subject to measurement and calibration law in its own right. Due to the widespread use of billing systems in the field of electromobility, especially in the charging infrastructure for passenger cars, the German Association for Metrology and Verification (Arbeitsgemeinschaft für Mess- und Eichwesen) has, in its uniform national practice, regarded time as a recognised measurand for the supply of electricity subject to calibration in accordance with Section 1 (1) (6) of the German Ordinance on Metrology and Verification (Mess-EV).[36]

36 Mühe/de Wyl: Rechtliche Rahmenbedingungen für die Abrechnung des Ladens von Elektrofahrzeugen, in: EnWZ 2018, 339 (340).

4.2.2.4. Flat rate

It is also possible to bill for the electricity purchased as a flat rate. A distinction must be made between flat rates that allow energy to be purchased within a certain period of time (also called flat rate) and a flat rate per transaction (also called session fee). A session fee is a flat connection fee per charging process. The ERS user pays a fixed price for each charging session, regardless of the amount of electricity used and the duration of the charging session. A flat rate is charged in the context of contract-based charging (within a continuing obligation) for a fixed period of time (month/year). A distinction can also be made between a 'true' flat rate and a 'false' flat rate. In the latter case, the price can be adjusted at the end of the reference period depending on consumption with effect for the next reference period (e.g. increase in the flat rate for the following month or year).

While both 'true' and 'false' flat rates are considered transparent, session fees are regarded as non-transparent due to the difficulty of estimating the service that can be purchased. However, unlike in the case of stationary charging points, this type of ERS billing is legally permissible in Germany, since consumer-protective price law does not apply to the relationship between ERS users and mobility providers (B2B). Section 3 of the Pricing Ordinance therefore does not prevent billing by session fee.

Moreover, a flat-rate tariff does not cover any relevant measured variable within the meaning of Section 1 (6) of the Measurement Ordinance (MessEV). Instead, billing is based on the number of uses (session fee) or a usage period (flat rate). However, the period of use must be a period of time determined by calendar or date. If this is not the case, for example, because the billing is based on the specific charging time (e.g. one hour), the time is determined as the measured variable, so that the measurement and calibration law would be applicable again.

If, in the context of a 'false' flat rate, the actual energy quantities used are recorded by the mobility provider in order to adjust the charge for future periods of use, this also does not constitute metering within the meaning of Section 1 (6) of the Metering Ordinance (MessEV), since the metered values only serve to create an offer that the other party does not need to accept. In the case of 'false' flat rates, this has consequences for the further contractual relationship. For example, an increase of the monthly flat rate in the following contract period due to higher energy consumption is possible. However, this does not represent billing according to a relevant measured quantity (kWh) in relation to the current contractual relationship and related invoicing, so calibration requirements do not have to be observed. The tariff level is linked to the previous usage behaviour. For the ERS user, it is transparent and clearly comparable whether other offers of a mobility provider are possibly more favourable or whether, for example, billing according to tariff distances is a better option.

It must be borne in mind, however, that flat rates transfer a considerable risk to the mobility provider. Particularly in the case of a 'false' flat rate, in which an advance withdrawal to be defined in more detail (e.g. the previous month, the average of the last 3 months, etc.) serves as the basis for determining the flat rate amount, the ERS user has an incentive to optimise between different mobility providers for the contract of the subsequent period.

When assessing the level of the flat rate, it should be noted that Directive 2012/27/EU on the internal market for electricity stipulates in Annex I (1) (d) (2) that prepayment systems must adequately reflect probable consumption. Accordingly, tiering by vehicle class can also be considered in the case of 'true' flat rates.

The Directive stipulates in Annex I (1) (2) (a) that information on actual consumption must be provided. Customers should thus be able to see and regulate their actual energy consumption. According to the wording, this does not include the requirement to bill on the basis of this consumption. A representation of the actual consumption is sufficient. Legal calibration requirements are therefore not to be observed in the case of metering. The information can also be provided in the case of billing by a flat rate. Since ERS are not charging points within the meaning of Art. 2 (3) of Directive 2014/94/EU, they do not fall within its scope de lege lata. However, the ICEM recommends the inclusion of ERS as a separate infrastructure category in the directive (cf. under 5.1.3).

Excursus: Challenges in the use of OBUs and the display of current tariffs

The OBUs currently on the market are only suitable for collecting a route toll. A new OBU with additional functions is therefore required for the use of OBUs in the context of ERS. First, additional interface modules are required for communication and data transmission. The software must also be able to process additional information, such as the status of the PAN and the energy values of the meter. Furthermore, an additional C2x module is required if current information on prices in the respective route section is to be transmitted. For this purpose, a transmitter (road-side unit) is installed at the route section. The fare information is transmitted via a central computer to this transmitter to OBUs that are within range. Alternatively, a price display can also be provided by a VMS matrix sign as a side display at the side of the road. The display of price trends would also be possible. Comparable to the price indication in the display of the OBU, the price development could also be displayed here for the ERS user. ERS vehicles equipped with a pantograph already have a specified interface that allows PAN status data (retracted, extended, power on or off) to be transmitted. In addition, a communication link to the meter module is required for the transmission of the energy meter values (kWh).[37]

4.3. Two levels of electricity billing

The lack of availability of meters that are compliant with measurement and calibration law makes an interim solution for billing ERS use necessary, insofar as the establishment of the ERS is to be started promptly. However, the chicken-and-egg problem described above may necessitate an interim solution for the market ramp-up, even if a longer period of time elapses before the ERS is established, since the development of a meter compliant with the calibration law is not expected to start until a successful market ramp-up becomes apparent.

This results in a two-stage model for electricity billing. In both stages, all ERS infrastructure costs (planning, construction, operation including loss energy and other system services, financing, etc.) are included in the road costs as described and allocated to all toll road users.

First stage: Due to the lack of availability of metering- and calibration-compliant meters, as well as the negligible electricity costs (compared to infrastructure costs) in the early market ramp-up phase, the billing of electricity costs to ERS users could therefore be waived in stage Ib. An advantage of this would be that ERS could be classified as economically attractive at an early stage (due to subsidies) because of low user costs, and the market ramp-up could therefore be accelerated. The electricity costs would have to be funded from tax revenues as a kind of subsidy for the switch to ERS lorries and could supplement or replace other subsidy instruments (market ramp-up premium).

However, giving away electricity in the market ramp-up phase can already set false incentives (waste of electricity or misuse), place an undesirable burden on households and increase acceptance problems among operators of conventional lorries. In addition, the stakeholder model with mobility providers described here can only be established in the second stage, although it is precisely the mobility providers that should gain experience as new market players in the market ramp-up phase. Therefore, the flat-rate billing of electricity according to the length of the tariff route (1a) is suggested as preferable. Giving away electricity would then only be an alternative option if billing according to tariff distances turns out not to be as easy to implement as assumed.

Second stage: In the second stage, the costs of the ERS infrastructure are included in the route costs and defrayed

37 Interview with Werner Pfliegl (Siemens Mobility GmbH, Senior Product Manager, AMELIE project) on 05.03.2021.

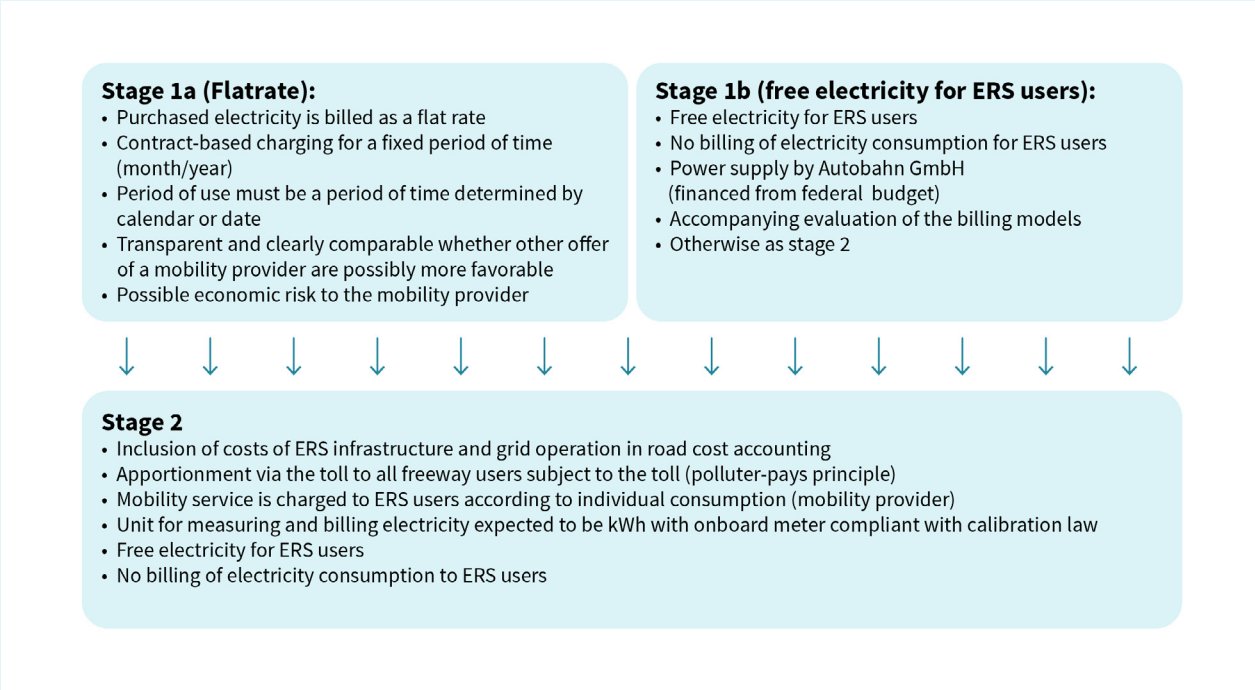

Figure 8: Two levels of electricity billing. Source: Own representation.

via the toll. In addition, the ERS user is charged for traction power according to individual consumption. The supply of mobility power is carried out by the mobility provider as a 'mobility service'. This designation serves the purpose of clarification, because it is to be distinguished from the power supply of the electricity supplier (electricity supplier is a designation from the EnWG, which is reserved for the supply of electricity via power supply networks). At the same time, the unit that is to be supplied with electricity and billed at the second stage has not yet been determined, as the relevant technical requirements have not yet been developed.

4.4. Implications for data processing

An essential component of a stakeholder model for the operation and billing of an ERS is the availability of data for the stakeholders. All stakeholders need a range of data to perform their tasks. These are the data already collected in connection with toll billing. For electricity billing (in the second stage), some of the data already collected in connection with toll billing will become relevant (number plates of the vehicle or vehicle combination, name and address of the user, identification number of the on-board unit, kilometres driven with the respective route sections). In addition, the contract number for the user's mobility service contract, the respective position of the lorry when it was connected to and disconnected from the ERS, the amount of energy drawn in kWh, and the time at which the electricity was drawn are required for electricity billing. The position is relevant because different tariffs may apply to different grid sections and because it should also be possible to change the mobility provider with regard to different grid sections (cf., e.g., National Variant 3).

All data are personal data, the protection of which is governed by far-reaching regulations under general European and national data protection law and special regulations under energy industry law and legislation on toll charging. For the stakeholder model presented in this paper, it is relevant that, due to the single-device approach pursued here, all data required for toll and electricity billing are collected via the OBU and are thus initially only available to the company that operates this OBU. Data protection for these stakeholders with regard to the processing of toll data is already comprehensively regulated with a high level of protection. It is important to build on this. From a regulatory point of view, it would be sufficient to extend this protection to the additional data that needs to be collected in connection with electricity billing and to regulate the transfer of data for electricity billing with a comparable level of protection.

4.4.1. Data processing and measurement in the European variant

In the European variant, the role of the EETS Provider is extended to include the tasks of a Euro-pean Electronic Mobility Service (EEMS) (EETS/EEMS Provider). 'EETS OBE is allowed to facilitate services other than tolling, provided that the operation of such services does not interfere with the toll services in any EETS domain' (Art. 3 (5) (3) directive (EU) 2019/520).[38] The EETS/EEMS Provider operates the OBU of its customers. All aforementioned data are transmitted from the OBU via the mobile network to the EETS/EEMS Provider's back-office system at regular intervals after the measurement. In the back office, the data is processed in such a way that it enables the EETS Provider to generate a toll bill and an electricity bill for the end customer. Both can appear on one bill but must be clearly designed as separate services. For EETS Providers, the data protection provisions are already regulated in § 13 of the EETS Admission Agreement.[39] According to Section 13 (1) of the EETS Authorisation Contract, the Provider must ensure that it complies with all data protection requirements at all times when implementing EETS. This includes, in particular, the requirements of European law and the special legal requirements of the MautSysG, the BFStrMG and – if the MautSysG and the BFStrMG do not contain any conclusive provisions – the provisions of the Federal Data Protection Act (BDSG) and the provisions of the European General Data Protection Regulation (EU-DSGVO). This obligation of the provider vis-à-vis the toll system operator applies regardless of whether the provider itself falls within the scope of such data protection provisions. According to Art. 5 (7–10) of Directive 2019/520/EU,[40] all Member States must already ensure that EETS Providers provide toll system operators and the competent enforcement authorities with all data they require for toll billing and, if necessary, law enforcement and enforcement, in compliance with data protection requirements. For their role as EEMS providers, the relevant guidelines would also have to stipulate that they provide the mobility providers with all the data they need for electricity billing and, if necessary, for legal enforcement and execution, while complying with data protection requirements. However, it should be noted here that the supply of the traction and charging power takes place on a private-law basis, and the mobility providers must use the courts for legal enforcement and do not have recourse to the toll enforcement authorities.

If, as in stage 2 described above, electricity is billed by kWh after an initial market ramp-up phase, each ERS lorry must be equipped with a meter that complies with measurement and calibration regulations in addition to the OBU in order to record the consumption data and forward it via the OBU. Another obstacle to a European interoperable billing solution is the fact that electricity metering and data storage of the metering results are not regulated at European level.

With regard to billing systems for charging points, the AFID Directive contains general requirements for the design.

According to Article 4 (10), the AFID Directive requires that the Member States ensure that operators of publicly accessible charging points charge prices for electricity consumption that are appropriate, simple and clearly comparable, transparent and non-discriminatory.

How the requirements are implemented in detail is left to the Member States themselves. This leads to different requirements from the national measurement and calibration law, which in turn can present an obstacle to European billing.[41]

The development in the area of charging points shows that the differences in the measurement and calibration laws of the Member States also stand in the way of European billing there.

In contrast, a European solution for electricity metering by kWh with a uniform European meter and corresponding data collection exists for the railroad sector (cf. Implementing Regulation 2018/868/EU). Based on this regulation, it

38 Directive (EU) 2019/520 of the European Parliament and of the Council of 19 March 2019 on the interoperability of electronic road toll systems and the facilitation of cross-border exchanges of information on non-payment of road tolls in the Union.

39 Vertrag über die Durchführung des Europäischen elektronischen Mautdienstes auf Bundesfernstraßen im Geltungsbereich des Bundesfernstraßenmautgesetzes (EETS-Zulassungsvertrag) vom 20. März 2018 (BAnz AT 27.03.2018 V2).

40 Directive (EU) 2019/520 of the European Parliament and of the Council of 19 March 2019.

41 TRAN-Ausschuss: Ladeinfrastruktur für elektrische Straßenfahrzeuge (2018), abrufbar unter: https://www.europarl.europa.eu/RegData/etudes/STUD/2018/617470/IPOL_STU(2018)617470_DE.pdf (08.12.2020).

would therefore be preferable to regulate electricity measurement by kWh and data storage of the measurement results in Annex III AFID. Transitional solutions would have to be provided for the market ramp-up phase, at least as long as no suitable meter for electricity measurement per kWh is available on the market for ERS lorries.

4.4.2. Data processing and measurement in the national variant

As long as the party incurring a toll does not commission an EETS Provider, the OBU is made available and operated by the toll system operator after user registration. It must make the data mentioned above available to the mobility provider for billing purposes. The toll operator may only use the collected and transmitted data for the purposes of toll collection and billing. The BFStrMG stipulates that data collected for toll billing purposes may not be transmitted to third parties under other legal provisions and may not be seized (Section 7 (2) (3)). Certain deletion periods apply to data stored during the collection and control of tolls (§ 9). The location data collected must be anonymised immediately. In order to maintain a correspondingly high level of protection even after the inclusion of the ERS, the BFStrMG should be amended to limit the transmission and processing of data required for billing to the mobility provider accordingly. Such a regulation is not mandatory, since it would also be sufficient to obtain the consent of the ERS user to data processing when the contract with the mobility provider is established. However, to avoid undermining the high level of data protection of the BFStrMG, a corresponding regulation would be preferable.

In the national variant, too, the recording of electricity according to kWh by a meter that complies with measurement and calibration law will probably be required in stage 2. If the European regulation of electricity measurement and data storage in the AFID suggested in the last section is adopted, this solution should also be used in the national framework. If there is no European regulation, the regulations of the German measurement and calibration law are sufficient. However, an inclusion of the necessary processes in PTB requirements 50.7 and 50.8 should be initiated in a timely manner so that all requirements for the meter and data storage are defined. This has long been neglected in the case of charging points; as a result, requirement of a metering- and calibration-compliant electricity delivery has slowed down the development of the charging infrastructure for a long time.[42]

42 See also the Measuring Instruments Directive (MID) 2014/32/EU (Annex V: Electricity meters for active consumption) and the PTB Technical Guidelines (Measuring Instruments for Electricity), available at: https://www.ptb.de/cms/ptb/fachabteilungen/abt9/fb-92/ag-921/921-publikationen.html (08.12.2020).

5. Recommendations

As described above, the stakeholder model presented here fits into the existing legal framework to a large extent and incorporates the objectives of the relevant European directives, regulations and German laws. However, without adaptation of the legal framework on a few key points, the widespread development and use of ERS will not be possible. A European interoperable solution in the sense of the stakeholder model introduced here would also require the selective adaptation of relevant European directives and regulations. However, the stakeholder model presented here was developed with the aim of keeping the need for adaptation as low as possible. Moreover, the recommendations provided here are compatible with the framework of the Basic Law (in particular Article 90 of the Basic Law) and the European treaties, and all proposed legal adjustments are within the scope of competence of the relevant standardising bodies.

5.1. Proposed amendments to European directives and regulations

In the Working Paper 'Models for the development of electric road systems in Europe',[43] IKEM presented a scenario for Europe-wide interoperable development and outlined the need for regulation at European level.

ERS as part of the trans-European transport network, Regulation 1315/2013/EU

- Adaptation of Regulation 1315/2013/EU for the purpose of clarification
- Explicit inclusion of ERS in Art. 17 (1) of Regulation 1315/2013/EU.
- Comparison of the scientific proposals for a core network for an ERS infrastructure (e.g. Hacker et al., StratON Final Report, Feb. 2020, p. 110f.) with the TEN-T core network according to Annex I of Regulation 1315/2013/EU, since the availability of alternative environmentally friendly fuels is prescribed on the TEN-T core network according to Art. 39 (2) (c) of Regulation 1315/2013/EU. (There is already a high degree of agreement here).
- Addition of the availability of ERS to Art. 39 (2) (c) of Regulation 1315/2013/EU.

Inclusion of ERS in the infrastructure costs directive (1999/62/EC)

- Adaptation of Directive 1999/62/EC for clarification purposes
- Explicit inclusion of ERS in Annex III (2) of Directive 1999/62/EC (infrastructure costs) and classification of individual cost items as construction costs, costs for operation, maintenance and expansion of the relevant transport infrastructure network, such that costs that are unusual for road construction and operation in particular are clearly covered (thus also clarifying that this is not a further incurrence of external costs).
- Explicit exclusion of mobility power costs from the infrastructures, with reference to the competitive market for traction and charging power to be established within the ERS.

Inclusion of ERS in AFID and EMD

- Adaptation of RL 2014/94/EU and RL 2019/944:
- ERS as a separate infrastructure category of Directive 2014/94/EU (definition in Art. 1 in distinction to charging point); definition of common European framework and minimum requirements for deployment and operation and reporting obligations (Art. 4, Annex I), inclusion in the national strategy frameworks of the Member States (Art. 3) with quantity structure (core network deployment), common technical specifications (Annex II) and requirements for user information (Art. 7).

43 Hartwig/Bußmann-Welsch/ Lehmann: IKEM Working Paper - Leitbilder für den Aufbau von elektrischen Straßensystemen in Europa, Okt. 2020, S. 16ff. Available at: https://www.ikem.de/wp-content/uploads/2020/12/20201216_WP_Electric-Road-Systems_EN.pdf.

– Definition of unbundling of the distribution network, ERS and mobility power supply and all necessary regulations for the establishment of a competitive market for mobility providers within the ERS infrastructure (Art. 33 RL 2019/944 and, if applicable, Art. 4 RL 2014/94/EU).

European Electronic Mobility Service (EEMS)

– Specifications for electricity measurement per kWh, measuring devices, data acquisition, transmission and storage of measurement results in Annex II of Directive 2014/94/EU based on the European regulations on on-board energy measurement systems (EMS) in the railroad sector (cf. Implementing Regulation 2018/868/EU) with transitional periods providing greater freedom to the Member States in the market ramp-up phase. (A transitional period is necessary because no measuring device for ERS lorries that complies with calibration law is currently available on the market).

– Mirroring of the regulation and regulation of a transitional solution (billing according to tariff routes) in the EESV.

– Directive 2014/94/EU and the EESV specify who operates the measuring device in the ERS lorry, including ownership of the measuring device. It would make sense to link this to OBU operation (toll system operator or EETS/EEMS operator) or self-operation by an appropriately qualified ERS user.

– Specify the tasks and obligations of the measuring device user in Directive 2014/94/EU and the EESV in coordination with the obligations of the OBU operator (if necessary, adapt Directive 2019/520/EU). This also concerns the question of ownership of the measuring equipment.

– Directive 2014/94/EU, Directive 2019/520/EU, EESG and EESV regulate data exchange and data protection regimes, with a clear assignment of responsibilities and specifications of which stakeholders may exchange and receive which data, based on the stakeholder model presented.

5.2. Proposed amendments to federal laws

Adaptation of the BFStrG

– Addition to § 1 (4) (1): the body of the road; these are in particular the road bed, the road substructure, the road surface, bridges, tunnels, electrical road systems for the power supply of motor vehicles while driving, culverts, embankments, ditches, drainage systems, embankments, retaining walls, noise protection systems, dividing, side, verge and safety strips;

– In § 2 (6) (a), a new sentence (2) is inserted: If a federal toll road is supplemented by an electric road system for the power supply of motor vehicles during travel, the new road section shall be deemed dedicated by the transfer of traffic for use by vehicles which have the technical prerequisites for power supply to the respective electric road system as evidenced by a corresponding entry under the heading P.3 'Fuel type or energy source in the registration certificate II', their vehicle registration certificate for vehicles with short-term number plates, or carry a document proving these prerequisites in international traffic.

– Inclusion of ERS in planning law, in particular for the purpose of coordinating commissioning with the state energy authorities (as a replacement for Section 4 EnWG)

– A new No. 7a is inserted after Section 1 (2) (7): No. 7(a) ERS vehicles within the meaning of Section 2 (3) (a) of the Electric Mobility Act, as amended, in the period from January 1, 2022 to December 31, 2028; however, as of January 1, 2028, the partial toll rates for infrastructure costs pursuant to Section 3 Paragraph 1 No. 1 shall be payable for such vehicles. (The periods are to be adjusted according to the assumptions for the market ramp-up phase).

– In Annex 1 No. 1 BFStrG, a separate toll class with its own toll sub-rate is introduced for different weight classes of ERS vehicles. The partial toll rates should initially be significantly lower than the rates for other vehicle classes (incentive effect), but may well be higher after a successful market ramp-up, since an additional part of the road (the ERS) can only be used for them. (A trade-off must be made with the

funding policy objectives, the funding concept in other respects and the burden on the federal budget; burdens for other vehicles with alternative drive systems must be included in the consideration.)

5.2.1. Energy Industry Law, Amendment of the EnWG and Addition of an Article Law

Amendment to the EnWG

- § 3 (15): '... with the exception of customer installations within the meaning of numbers 24a and 24b and electrical road systems,'
- § 3 (24) (e): 'electric road systems are electric installations which, as part of a road, serve to supply power to motor vehicles while they are in motion,'
- § 3 (25): 'Final consumers: Natural or legal persons who purchase energy for their own consumption or as mobility providers for resale as mobility power via an electric road system; also the electricity purchase of the charging points [...]'
- § 3 (26) (d): 'Mobility providers: Natural or legal persons who supply electricity to others via an electric road system.'
- § 17 (1) EnWG: '[...] charging points for electric vehicles, electric road systems, generation and [...]'

Addition of sections 49a ff. to the EnWG via an article law (Fahrstromgesetz):

- Basis of authorisation similar to para. 49 (4) for issuing an EESV. Deviating from this, however, the responsibility would have to lie with the BMVI, or at least include it, since Autobahn GmbH acts as the operator and all ordinances relating to toll roads and road traffic fall within its area of responsibility.
- Regulation of the operation of the ERS infrastructure and the market organisation within the traction power network, in particular responsibilities; notification of the activity of mobility providers in a defined grid section (cf. § 5 EnWG); regulations on the unbundling of mobility providers, ERS operators, toll system operators and distribution system operators and the use of information (cf. §§ 6 and 6a EnWG); tasks of the ERS operator (cf. §§ 11, 12 and 14 EnWG), technical regulations also for ERS users and mobility providers (where these are not to be regulated by standards or the EESV, cf. slide 15); non-discriminatory access to the traction power network by mobility providers and mobility provider switching (cf. §§ 20f EnWG); provision of balancing services by the ERS operator and their billing (cf. § 22f. EnWG); powers and delimitation of competences of the regulatory authorities, in particular FBA, BAG; BNetzA.
- According to § 42 (1) and (2) EnWG, an EESV must regulate the obligation of the mobility provider to disclose to customers the electricity composition of the electricity they supply.
- Note: Regulation is not required for grid connection (public use under regulation of StVO) and grid charges (ERS operation is financed via the federal budget and included in toll financing).

Issue of an 'Ordinance on the Regulation of Energy Systems for Electric Road Systems (EESV)':

- Details and technical issues relating to the operation of the ERS infrastructure and the market organisation in the traction power network, insofar as they do not have to be regulated by formal law and are better dealt with in a regulation due to the flexibility required.
- Implementation of the regulations of a Directive 2014/94/EU adapted to ERS.
- Maximum possible coordination with the LSV, as far as this is necessary for technical interoperability and the interaction of the markets. (Note: electricity for the batteries of the lorries can be obtained via both infrastructures, and interactions must be taken into account in the regulation.)
- De lege ferenda, corresponding regulations should be made in the proposed Regulation of Energy Equipment for Electric Road Systems (EESV). The corresponding regulations on price and supply conditions as well as electricity bills in the Energy Industry Law (cf. 39 and 40 EnWG) serve as an example here.

5.2.2. Competition law

– Regulations for the protection of ERS users should be subject to sections 3 and 5 PAngV of the Ordinance on the Regulation of Energy Systems for Electric Road Systems (EESV). Accordingly, provisions should be imposed requiring the respective OBU to display the name of the current route section as well as the price per kWh or route section. The corresponding information is sent from the OBU operator to the OBU via a 'road-side unit'. In addition, the prices per kWh or route segment must be visible on the mobility provider's website.

– It would be possible, for example, to specify the advance publication of prices per network section on the mobility provider's website at least two days in advance (predictability) and to require a transparent display of the routes already driven with price and consumption immediately after the trip (immediate traceability of consumption in retrospect).

– Price displays on change indicators at the roadside do not make sense because of the different prices of possible mobility providers (cf. regulatory purpose of § 33 (1) StVO).

5.2.3. Adjustment to the balancing group system and substitute supply

In the ESSG and the ESSV, regulations coordinated with ERS must be made regarding the regulation of the balancing group system and the system of substitute supply in the EnWG. Smooth operation of ERS and trouble-free operation of the upstream networks in the existing balancing group system requires the following:

– inclusion of ERS lorries in the balancing group system based on traction power supply and

– regulation of a fall-back supply comparable to the substitute supply (cf. Section 38 EnWG) in the traction power supply.

One possible option to avoid disturbing the balancing group system is outlined here (details and options of this system will be described in the AMELIE II project):

– The ERS operator becomes the balancing group manager for all withdrawal points at the ERS substations as the fallback manager (one balancing group per control zone). All energy quantities that cannot be allocated to a mobility provider and its electricity supplier (fall-back balancing group) are included in this balancing group.

– The ERS operator becomes a substitute supplier for all ERS users without a mobility service contract and places them with mobility suppliers as quickly as possible in a regulated competition-neutral procedure in order to avoid longer substitute supply (this type of substitute supply is not covered by § 6ff. EnWG/ Art. 35 Directive 2019/944/EU, as the ERS operator is not a distribution system operator). Alternatively, the uniform award of the substitute supply to a mobile provider would also be conceivable, which could, however, lead to a strong market position of this provider.

– Electricity suppliers must include a tapping point for each substation supplied as part of their supplier master agreements and include it in the respective bi-lance circuits for the control area. For identifiable ERS lorries with a mobile service contract, the energy quantities are taken out of the respective balancing group of the ERS operator and added to the balancing group of the respective electricity supplier for the control area. The electricity supplier reports all of the withdrawal processes assigned to it in this way to the grid operator of the upstream grid (regularly as the balancing group manager) and additionally to the ERS operator so that the latter can deduct them from its balancing group for the respective substation.

– A separate mechanism is established in which mobility providers report their customers (ERS users) operating in a route section and their estimated electricity consumption to their electricity supplier. In addition, a mechanism is needed to offset the actual withdrawals that are later calculated.

5.2.4. European Solution in Measurement and Verification Law, MessEV

Annex 1 No. 6 a) MessEV is supplemented by (ee): 'ee) in ERS vehicles within the meaning of § 2 No. 3a EMoG'. Adaptation of Directive 2014/32/EU (MID) to include basic requirements for electricity metering devices on the ERS lorry.

- The ERS operator becomes a substitute supplier for all ERS users without a mobility service contract and places them with mobility providers as quickly as possible in a regulated competition-neutral procedure in order to avoid longer substitute supply (this type of substitute supply is not covered by § 6ff. EnWG/ Art. 35 Directive 2019/944/EU, as the ERS operator is not a distribution system operator). Alternatively, the uniform award of the substitute supply to a mobile provider would also be conceivable, but could lead to a strong market position for this provider.

- Electricity suppliers must include a withdrawal point for each substation, supplied as part of their supplier master agreements, and include it in the respective balance circuits for the control area. For identifiable ERS lorries with a mobile service contract, the energy quantities are taken out of the respective balancing group of the ERS operator and added to the balancing group of the respective electricity supplier for the control area. The electricity supplier reports all of the withdrawal processes assigned to it in this way to the network operator of the upstream grid (regularly as the balancing group manager) and additionally to the ERS operator so that the latter can deduct them from its balancing group for the respective substation.

- A separate mechanism is established in which mobility providers report their customers (ERS users) operating in a route section and their estimated electricity consumption to their electricity supplier. In addition, a mechanism is needed to offset the actual withdrawals that are later calculated.

5.2.5. Regulations on measuring equipment and measurement

- Specifications for electricity measurement according to kWh, measuring devices, data acquisition, transmission and storage of measurement results in Annex II of Directive 2014/94/EU based on the European regulations on on-board energy measurement systems (EMS) in the railroad sector (cf. Implementing Regulation 2018/868/EU) with transitional periods that provide greater freedom for the Member States in the market ramp-up phase. (A transitional period is necessary because no measuring device for ERS lorries that complies with calibration law is currently available on the market).

- Mirroring of the regulation and regulation of a transitional solution (billing according to tariff routes) in the EESV.

- Directive 2014/94/EU and EESV specify who operates the measuring device in the ERS lorry, including ownership of the measuring device. It would make sense to link this to OBU operation (toll system operator or EETS/EEMS operator) or self-operation by an appropriately qualified ERS user.

- Specify the tasks and obligations of the measuring device user in Directive 2014/94/EU and EESV in coordination with the obligations of the OBU operator (if necessary, adapt Directive 2019/520/EU). This also concerns the question of ownership of the measuring device.

- Directive 2014/94/EU, Directive 2019/520/ EU, EESG and EESV regulate data exchange and data protection regimes, with a clear assignment of responsibilities and specifications of which stakeholders may exchange and receive which data, based on the stakeholder model presented.

5.2.6. Amendment EMoG and follow-up regulations:

Addition of a No. 3 (c) to § 2 and all regulations based on it for hybrid lorries that are ERS-capable but do not have energy storage systems as defined in No. 3 (b). The definition of electric vehicle in Art. 2 (2) of Directive 2014/94/EU should also be expanded accordingly.
Addition of pollutant levels for hybrid lorries to Section 3 (2) and all regulations based on it, entitling them to claim the corresponding preferential rights.
After § 2 (3), a new No. 3 (a) and No. 3 (b) are inserted:

- 'No. 3 (a) An ERS vehicle is an all-battery electric vehicle or an externally rechargeable hybrid electric vehicle that can also be powered and charged while driving by an electric road system.'

- 'No. 3 (b) An electric road system (ERS) is an electrical facility that serves as part of a road to supply power to motor vehicles while they are in motion.'

Inclusion of a separate label in § 4 and all regulations based on it, which allows ERS lorries to be labelled independently, indicating that they are electric vehicles and which ERS they are allowed to use based on their technical requirements.

5.2.7. Adaptation of the InfrGG

- A new sentence (4) is inserted after Section 5 (2) (3) InfrGG: Insofar as the inclusion relates exclusively to the planning, construction, operation and maintenance of electric road systems pursuant to Section 2 (3) (b), the contract may extend to individual projects with a total scope of up to 400 kilometres.

- After the involvement of Autobahn GmbH, the task of ERS operation is transferred to it by the BMVI (organisational decree).

- In order to comply with the telos of the route limitation in Article 90 (2) of the Basic Law, the new provision should stipulate that the contract is not awarded to a company that has already planned and built or operates the respective highway section and that no contiguous grid sections are awarded to one company.