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Charging infrastructure interoperability in Europe

Sébastien Albertus, Electric Vehicle Quality and Services Director, RENAULT,
Chairman eMI3
1 avenue du Golf
78288 GUYANCOURT
FRANCE
sebastien.albertus@renault.com

Abstract

On 29th September 2014, European Union ratified the Alternative Fuels Directive which requires Member States to develop national policy frameworks for the market development of alternative fuels and their infrastructure; foresees the use of common technical specifications for recharging and refueling stations; and paves the way for setting up appropriate consumer information on alternative fuels, including a clear and sound price comparison methodology.

An important pillar of this directive is to ensure interoperability of public charging infrastructure. In order to support EU Member States in the implementation of this directive, a sub group of experts has handled this interoperability topic and proposed standardized ICT solutions (communication, data), and processes under the umbrella of the European Commission. The key insights and recommendations arising from their work will be presented in this paper. Those shall be turned into an MoU to be signed by industry members under the patronage of EU in order to reach a de facto common understanding and implementation of interoperability throughout Europe

1 Header

On 29th September 2014, European Union ratified the Alternative Fuels Directive which requires Member States to develop national policy frameworks for the market development of alternative fuels and their infrastructure; foresees the use of common technical specifications for recharging and refueling stations; and paves the way for setting up appropriate consumer information on alternative fuels, including a clear and sound price comparison methodology. An important of the pillar of this directive is to ensure interoperability of public charging infrastructure.

However, this sole word “interoperability” is facing different interpretation among public authorities or Charging pole operators. Role of actors in this value chain has to be defined, list of services covered by interoperability concept requires definition.

Therefore, in order to support EU Member States in the implementation and local declination of this directive, a sub group of experts has handled this interoperability topic and proposed standardized ICT solutions (communication, data), under the umbrella of the European Union Commission.

This paper shall present the key insights and conclusions of this expert group, through

- State of the art of infrastructure (connectivity, communication
- State of the art of interoperability
- Conclusions

The work of this group takes into full account the important interfaces with adjacent energy focused European Directives, such as key revisions proposed in the November ‘Clean Energy for all Europeans’ legislative packages.

The group’s work therefore anticipates the role that charging poles are likely to play as part the growth and proliferation of smart grids across the EU and be recognize both the as key interoperability challenges as well as the key enabling role that smart charging solutions can play in supporting grid stability..

1.1 Main focus of Alternative fuel Directive regarding electric vehicle charging infrastructure

One of the main customer rejection factors often cited for non-engagement with Electric Vehicles related to autonomy and access to charging solutions, when and where they are required. The inability of an Electric Vehicle driver to **locate, find and pay for power** for their vehicle is significant pain point which damages the driver experience. The Alternative Fuel Directive seeks to address this issue partially in relation to charging infrastructure by closing rules on connectors and type of current (AC or DC). The Directive is also tackling the principle of interoperability through two core concepts:

- Ad’hoc payment
- Contract based payment

These concepts are aimed at facilitating a seamless driver experience, by ensuring easy search and find of compatible and available poles and through easy access to a payment medium. It is important to note that both the accessing and payment for charging services shall be non-discriminatory.

However several thousands of charging posts already exists and industry have already developed in some countries interoperability solution.

The following chapters will introduce the ‘state of the art’ and then describe the expert group’s key beliefs as to what is feasible in order to fit EU guidelines and therefore deliver increased levels of interoperability to the benefit of Electric Vehicle drivers across the EU.

1.2 Current status of infrastructure

1.2.1 Number of public charging points

The precise identification of the exact number of public charging points in operation, national is difficult to evaluate. This is in some part down to the fact that each EU Member State uses a different basis through which to determine this number. The consequence of this is that EU Member State databases of public charging infrastructure is lagging behind reality.

This table shows a presents a picture as of November 2016 based on the cross-national evaluation of poles performed aggregated from data made available by Tomtom, e-mobility Clearing Houses, Renault, Nissan and BMW.

Country	Nr of EVSE
Austra	1826
Belgium	1125
Switzerland	400

Germany	6325
Denmark	1507
Spain	751
Finland	1040
France	22993
Great Britain	5522
Italy	1200
Lithuania	294
Netherlands	27285
Norway	7533
Portugal	1178
Estonia	324
Sweden	3130
Croatia	63
Slovenia	216
Ireland	849
Northern Ireland	79
Total general	83640

Amongst the detailed charging points above are more than 2000 QC along highways (3 standards AC Type2, Chademo and CCS) – installed or committed within Ten-t framework.

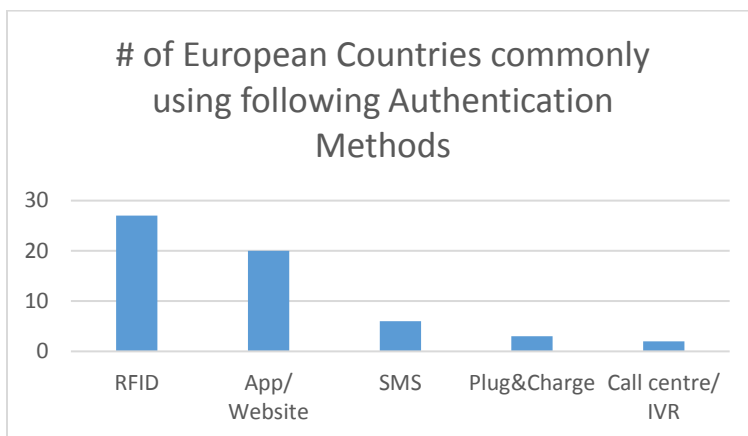


1.2.2 Charging station description

Initial analysis based on 10,000 field tests performed by Renault, indicates that currently 98% of points are connected to a backend, with one energy meter per supply equipment. However, only 90% of these charging points equipped with RFID readers. Moreover, 20 % of these points have a screen (100% of Quick chargers) but out of those, slow charge poles have basic small 4 line screens. QC have bigger screens but in any case those screens are aiming at supporting charging process (under authentication, charging, charge not allowed ...) and display consumption in kWh. In none of these cases, is a dynamic display available allowing for the presentation and performance of specific charging services. In other words, texts are pre-embedded in hardware and cannot be transmitted via existing backend to pole protocols such as OCPP. Moreover, the number of available languages is highly limited.

Analysis with regards to the availability of ad'hoc payment services illustrates that currently, less than 2% of the charging points identified are equipped with Credit card device.

Furthermore, remote access is more and more widely spread. Remote access means pushing a starting request from a backend.



Remote monitoring status is between 1sec and 15min

Even though car presence sensors are not so costly, less than 1% of poles are linked to car presence sensor. With respect to ad'hoc payments by credit card, this is a service offering which from a customer/driver perspective is appealing. However, the additional costs this brings to infrastructure, and the lack of a standardized business model through which to recover costs contributes to the poor current roll out among existing charging points and therefore makes it a local, rare solution.

Remote controllability of poles allow other ad'hoc payment related to phone and internet. However, in order to ensure seamless customer experience from navigation to charge, fulfill smart grid services and to better handle customer charging concerns, a more sophisticated solution is required:

- Through roaming
- Through multi-contract based
- Through high level ICT services.

The above approaches are described in this paper and will be demonstrated during conferences.

1.2.3. Description of a charging session

Guiding towards a charging pole and describe it on web or on Electric vehicle navigation may seem pretty easy however, looking at real field implementation many situations occur.

The examples below show how heterogeneous situation is throughout Europe. Therefore in its standard document, eMI3 has defined several concepts for searching and finding charging stations :

- Drivers are guided towards **pools** of charging stations that share same geographical location.
- Drivers are then parking in from of a **charging station** and authenticate on it.
- Then he connects on an **EVSE** (Electric vehicle supply equipment), i.e. part of the pole connected to an electric point of delivery and corresponding to a parking slot.
- Driver is then using one of the compatible **connector** offered on this EVSE.

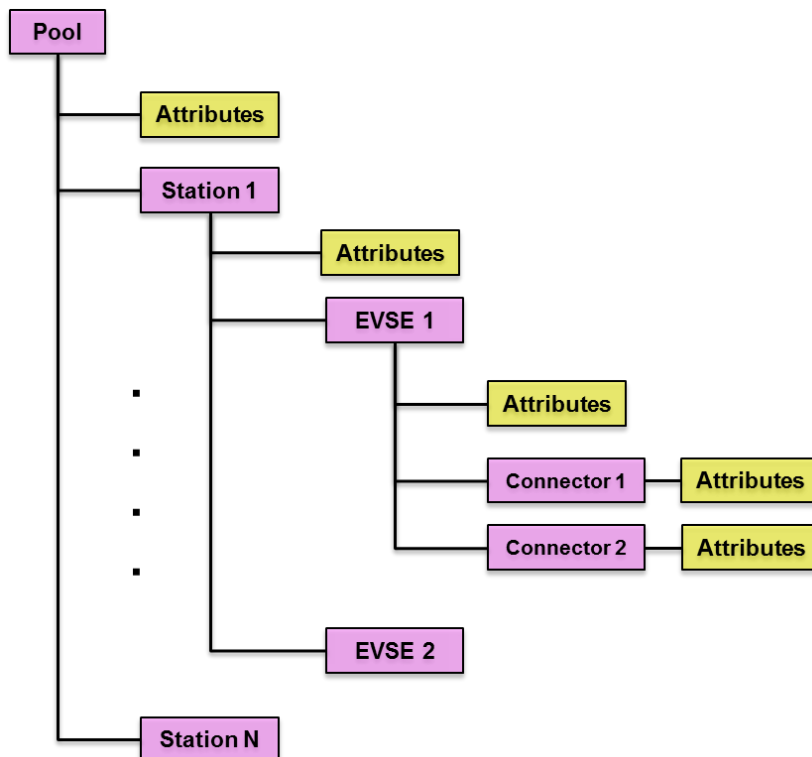
Every level of data (pool, station, EVSE, connector) is further defined by a set of attributes.

For instance, a pool is defined by a location and a brand

A station is defined by authentication means, features such as screen ...

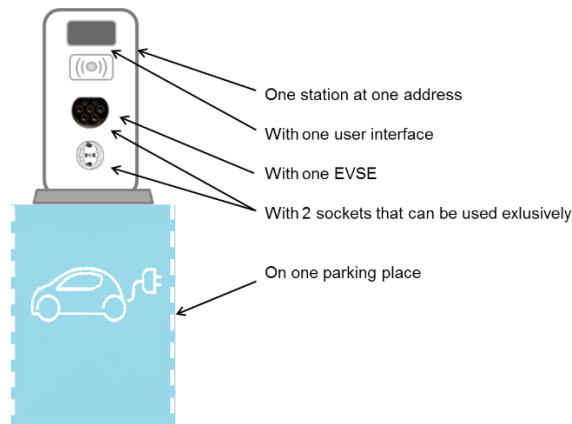
An EVSE is defined by its power and the type of sockets.

The picture below summarize the data structure that is needed to describe charging infrastructure.

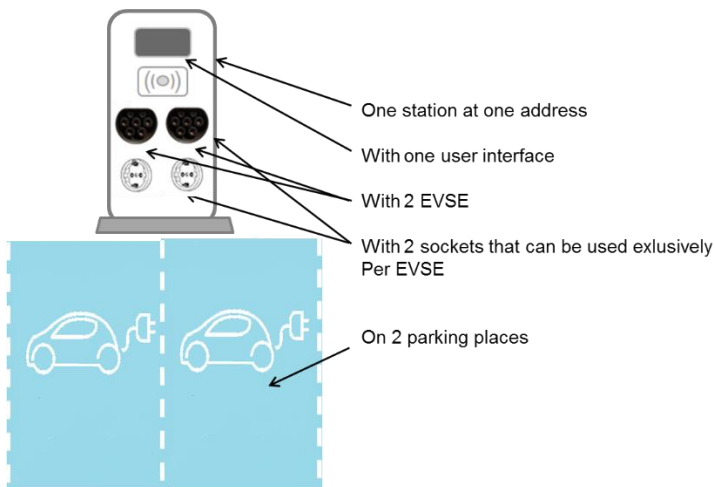


Examples of public charging infrastructure :

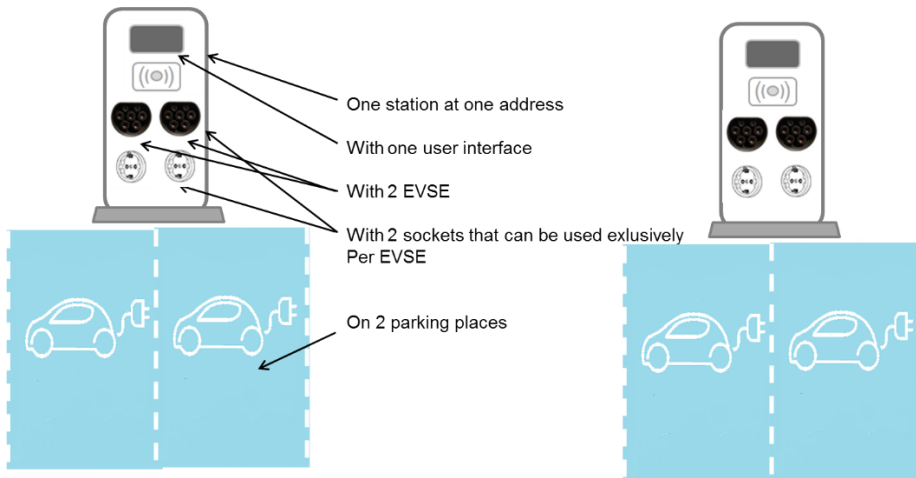
1. Picture p2-5 : one pool made of single charging station with one EVSE



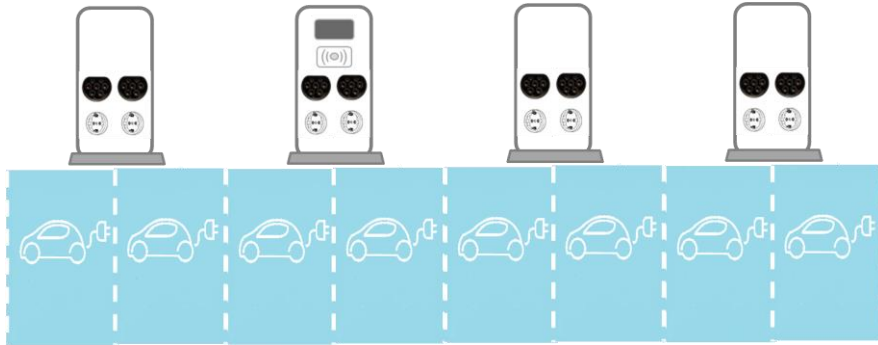
2. Picture p2-6 : One pool made of one single charging station with two EVSE



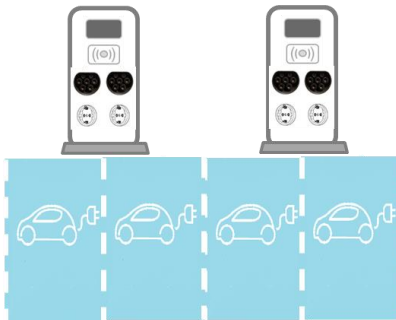
3. Picture p2-7 : two pools at 2 different addresses with one charging station with two EVSE each



4. **Picture p2-8 : One pool at one address made of one station with 8 EVSEs**

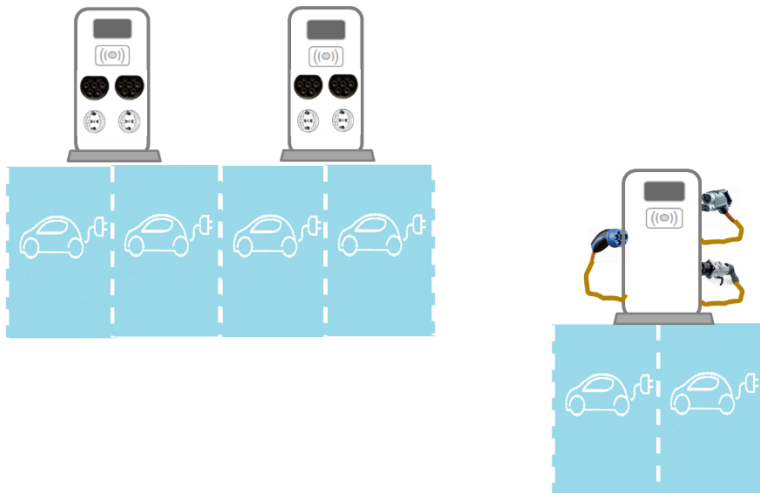


5. **Picture p2-9 : One charging pool with two charging stations**



One pool made of 2 stations each made of 2 EVSEs, at the same address

6. **Picture p2-10 : one charging pool with 3 charging stations : one quick charger and 2 standard stations with 2 EVSE each**



7. Picture p2-11 : two charging pools and four charging stations at one same address



One pool made of one Quick charge station able to serve AC and one DC simultaneously (1 EVSE AC side, 1 EVSE DC side)
And One pool dedicated to car sharing with 3 stations of 6 EVSE each

...

Alternative fuel Directive requires every member state to register and count public charging infrastructure. The explanation here above shows that if a data structure is not clearly shared, some member states can count per station and others per EVSE/parking slot.

Recommendation is to use the pool/station/EVSE data format in every member state repository.

1.3 What is interoperability ?

Interoperability is the ability to enable various systems to work together. For the eMobility market, interoperability leads to non-discriminatory eMobility services, such as charging and navigation, and makes it available through-out a defined territory (in this case Europe) without limitation and with a coherent service quality level, at an optimized price.

From a customer point of view, Interoperability is the ability to use the Electric Vehicle Charging Infrastructure (EVCI) wherever it is located, whatever the vehicle, whatever the operator that manages the Charging Point etc.

The typical user or customer journey is a long list of questions, of difficulties and likely of blocking points:

- “Where are the available Charging Points around me?”
- “How to use this Charging Point? Swipe my badge? Where? Push a button? Plug the cable first?”

- “Is my authentication media compatible with the reader?”
- “Am I authorized to access to the service on this Point?”
- “May I use my contract with my recharge services provider to use and pay this Charging Point?”
- “Is the socket of the Charging Point compliant with the cable I have?”

To meet these customer requirements, the ecosystem has to provide features that can be spited in 4 groups:

- Charging points technical features (authentication media, plug and socket compliancy ...)
- Charging points functional features (markings, how to use ...)
- System (system interconnection, data exchanges ...)
- Business & legal features (roaming agreements between operators ...)

From an operator point of view, Interoperability is the ability of an eMobility service provider to deliver its own services (search and find, charge, book, etc.) to its customers, using the infrastructure of any charging operator, under the umbrella of a B2B relationship at negotiated price

1.3.1. Actors of the value chain

4 type of players have to be considered in the current Electric vehicle charging ecosystem :

- Charging pole operators (CPO) :

Such companies own and operate a network of charging stations.

- eMobility service providers (in literature, several abbreviations are used : EVSP, eMP or eMSP)

Such companies are in direct contact with customer. They offer them charging services whatever charging network is. They register customers and charge them for charging acts.

- Navigation service providers

Mainly car manufacturers, such companies are offering solution to visualize and guide drivers towards any charging station.

Navigation service providers are a subset of eMobility Service providers.

- Roaming platforms (ERP) :

Such companies put through charging pole operators and eMobility service providers.

Mainly 3 companies are assuming this role : GIREVE, e-Clearing.net and Hubject

1.3.2. Interoperability standards between actors

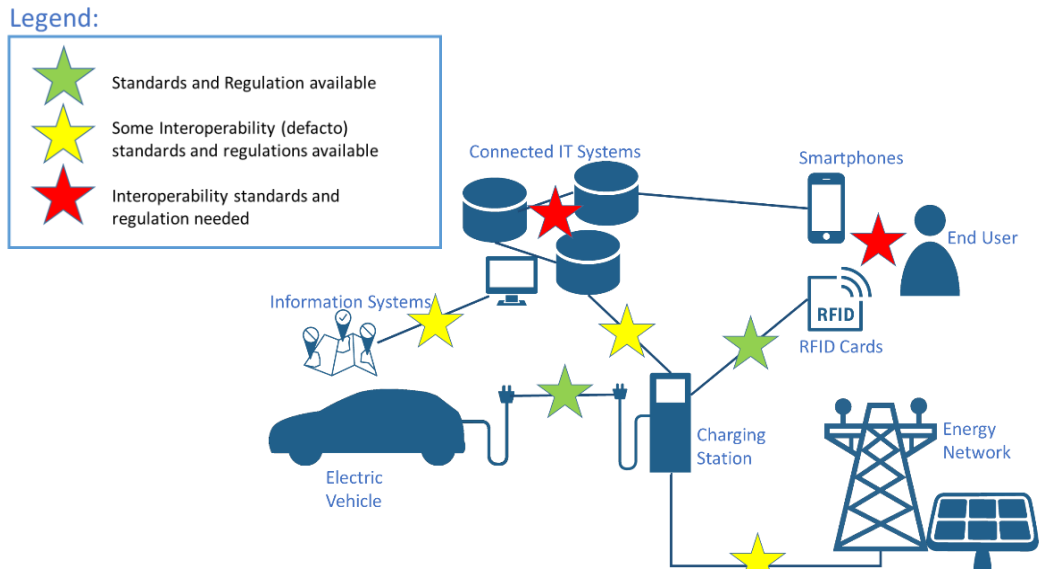


Figure 1

Figure 1 highlights that whilst some work is already underway; ‘interoperability blind spots’ remain which are yet to be resolved. This means there is a need for a continuous work between all stakeholders (industry, experts, regulation, municipalities etc.) to foster interoperability. This is a role that EMI3 is well positioned to support with,

Given that interoperability is a key challenge for the global eMobility industry and, if left unresolved, will continue holding back the uptake of electric driving. The eMobility market requires plug and play systems and hardware for all its actors, such as those described in this paper.

Some topics are already considered such as:

- Tariffs data model
- Booking services
- Load management

This Expert group is recommending to continue its task to support EU DG Move with updates.

1.3.3. Recommendation of the Group

The expert groups recommend to push ad’hoc payment mainly focused on remote solutions and without focusing on credit cards, since all poles are connected and phone based solution are most used.

Moreover, by interoperability, the group understands set of services allowing easy charging experience everywhere on every CPO, included as a minimum : searching and finding available compatible poles and charging. Therefore, contract based solution is best to achieve such role.

Considering the number of CPOs throughout Europe (1000), roaming is a possible enabler.

1.4. Interoperability implementation

1.4.1. Registering and Identifying actors

A parallel can be drawn with banking or phone industry : to be interoperable, actors shall be registered and identified by a unique identifier referring to each and every actor according to its role in the charging services.

Therefore, every charging pole operator should get an identifier and every service provider should also get one. To every combination between a charging pole operator identifier and every service provider identifier should be associated a B2B contract describing their business conditions such as tariffs, SLAs

To foster and speed up interoperability, in most cases, roaming platform also offer a default contract.

4 ID issuing agencies exists in Europe so far (AMP, AFIREV, e-Violin and BDEW). Their role is recognized by industry and EU authorities. Recommendation of the group is to rely on one of those. Or to set a local organization having a liaison with existing ones. Identifier structure is the one presented below

The ID structure is the following : <Country Code> <Provider ID>, for instance FRRN0

<Country Code> = 2 ALPHA

; two character country code according to ISO-3166-1 (Alpha-2-Code)

<Provider ID> = 3 (ALPHA / DIGIT)

; three alphanumeric characters, referring to the EVSP

1.4.2. Align member states and industry on those rules and principles

During EVS30, **an MoU open to all industry players will be presented**. It will refer to the **hereabove rules** and first signatures should happen during the event. This MoU will be proposed under the patronage of European Union.

It's aiming at aligning players and offer seamless and coherent customer experience.

1.4.3. Next steps

Evenif MoU and technical documentation that goes with should help implementation of interoperability. First findings after more than 2 years of real life operations show that unfortunately consistency among charging pole operators is a key concern. In other terms, there are huge discrepancies among operators in :

- Data consistency and coherence of attributes

- Time to refresh datas and reactivity
- Time-outs
-

Unfortunately from EV driver perspective quality of charging service is given by worst operator. A quality and consistency shall be next challenges.

Currently, major focus is on search and find a charging station and authentication use cases.

New Use-cases are underwork :

- Booking a charging pole.

This service is proposed by roaming platforms but hardly implemented so far either par Charging pole operators as well as eMobility provider.

This Use-case is still under process mainly because there is no real well-described and shared use case to handle charging station occupation

- Load management

This service is aiming at managing load of EV merging customer constraints (State of charge, departure time ...), Grid constraints and energy market opportunities, in order to improve global economics of value chain.

This Use-case is also still under process since there is no energy tariff to support and trigger its implementation.

2 Referencing

Interoperability definition : AFUL <http://interoperability-definition.info/>

EU Energy Directive pack, see <https://ec.europa.eu/energy/en/news> and http://europa.eu/rapid/press-release_IP-16-4009_en.htm

DIRECTIVE 2014/94/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 October 2014 on the deployment of alternative fuels infrastructure : <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32014L0094>

eMI3 standard document, <http://emi3group.com/>