400 companies joined the consortium

\_ tepco problems with Fukushima no R&D

In fact, there are 4 major industrial consortia in the industry

Presentation of CHAdeMO

CHAdeMO is an association whose goal is to promote a universal DC fast charging standard for electric vehicles. This objective will accelerate the deploying of infrastructure and accelerate the use of electric vehicles. Created in 2009, it is originally a consortium of Japanese companies, rapidly joined by many multinational companies. They set up many standards and technical requirements, such as the voltage, the security norms, the type of plug.

History of CHAdeMO

**2005 start of R&D project in Tepco about charging stations**

Jul 2009 Market launch of i‐MiEV (Mitsubishi) and Plug‐in Stella EV (Subaru), the first CHAdeMOcompatible EVs

Aug 2009 Foundation of CHAdeMO Association preparatory group

**Mar 2010 Inauguration of CHAdeMO Association**

Apr 2010 Publication of CHAdeMO standard specifications rev.0.9

May 2010 Start of charger certification procedure

Dec 2010 Market launch of Leaf (Nissan)

Jun 2011 Launch of Connector WG

Oct 2011 Launch of Specification 1.0 WG and V2H Extension Guideline WG

Jan 2012 Publication of CHAdeMO standard specifications rev0.9.1

May 2012 CD review for IEC 61851 finalized in IEC meeting (Tokyo), CDV to be reviewed

**Sep 2012 Publication of JIS standard specification (TS D0007)**

Apr 2013 CDV status for IEC61851 approved in IEC meeting (Toronto)

May 2013 Publication of CHAdeMO standard specifications rev.1.0.0

Nov 2013 Release of V2H Guideline 1.0

Jan 2014 FDIS approval of IEC 61851‐23, 61851‐24

2013 Standards : IEC 61851-23 for the charging system, IEC 61851-24 for communication, and IEC 62196-3 for the connector

CENELEC (European official standards organization) recognizes CHAdeMO and Combo as European official standards (EN).

(2013 activity report)

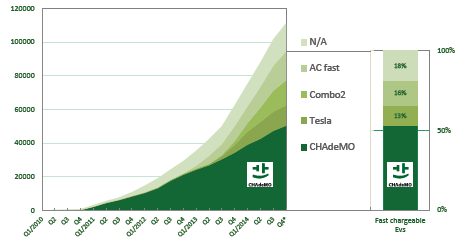
Strength of the company

Market share

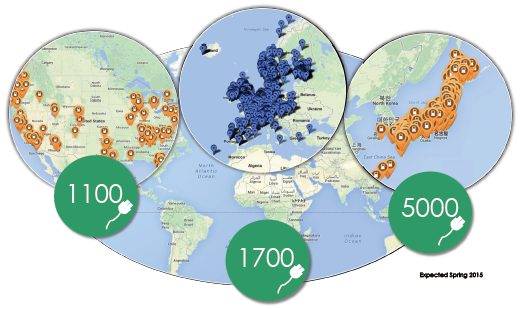
Sales of EV in 2010-2014 : 368000, 80% fast chargeable

1100 US, 1700 Europe, 5000 Japan

More than 50 chaging station manufacturers



(final english brochure 2013)



Deployment of CHAdeMO fast charger across the world (final English brochure 2013)

In September 2012, there are 2,492 charging stations in operation, more than 70,000 compatible EVs (about 80% of all EVs).

Interest of fast charging stations

R&D of CHAdeMO

Even if the association was officially created in 2009, the R&D projects that lead to the current standard of CHAdeMO fast charging stations date back to 2005. TEPCO, the main Japanese utility, started research projects on the electric vehicle mobility, that resulted in many patents and the basis for the technology used today. The different companies of the consortium cooperate on the research for the establishment and optimization of the CHAdeMO standards. Regular Infrastructure and Technical workshops are held to share the stakeholder’s experience with the CHAdeMO standard, and to improve the technology.

Patents/ technical specifications

Using the patented technology of TEPCO developed from 2005, the technology is an automotive fast charging technology for high voltage (up to 500VDC) and high current (up to 125A). The main characteristics of the standard are:

\_ the safety of user specifications

\_ the connector inlet: one AC and one DC inlet to help customer make the difference

\_ the communication system (CAN) : physical communication network on the vehicle between the battery and the charger control unit. It allows notably to avoid to provide energy through the inlet before it is safe, can transmit battery parameters to the charging stations (when to stop charging, target voltage, battery capacity, how the station should vary its output current).

\_ output power: tradeoff between the cost of the system (charger power, connection to the grid), and the benefit (time to charge the battery): according to the manufacturer, the level is up to 50kW

\_future flexibility : the system allows to go up to a current of 200A in the future, which will correspond to 100kW. Due to the superior price it will lead to, and the fact that it is not useful now because of the state of the market, the level is kept at 50kW.

\_ compatibility with smart grids: it is compatible for Vehicle-to-Home systems: allows to be connected to Home Energy Management System (connection with photovoltaic panels in the roof, optimization of charge and discharge)

Consequently, the CHAdeMO standard lets possible many evolution for the future, and only focus on the critical parts of the charging station that ensure compatibility. The rest of the charger has to be developed by the manufacturer that want to tap the market.

Reference :

<http://self.gutenberg.org/articles/CHAdeMO#References>

website of Chademo

With whom do they do business

B2C/B2B companies government

CHAdeMO being a consortium, it gathers many organizations. Today, 341 organizations in 38 countries are represented in CHAdeMO. Nevertheless, CHAdeMO comes originally from Japan. The secretary members of the consortium are:

\_ Toyota Motor Corporation

\_ Nissan Motor Co., Ltd.

\_ Mitsubishi Motors Corporation

\_ Fuji Heavy Industries Ltd.

\_ Tokyo Electric Power Company, Incorporated

\_ Fuji Electric Co., Ltd.

\_ Hitachi, Ltd.

\_ Honda Motor Co., Ltd.

\_ Panasonic Corporation

(website CHAdeMO)

The companies involved in the association can be charging stations manufacturer, automotive companies, battery manufacturer, energy utility. They all have a role to play in the electric vehicle market as well as in the charging station market.

Member list of ChaDeMo to put in Annexe



(final English brochure)

Automotive manufacturers

We need to highlight the leading role of Nissan in the charging station market thanks to the leaf

Partnership

Private/public charging stations

Strategy

Impact on the market

The use of the standard CHAdeMO has many consequences. The first one is the mutualization of the resources of many organizations to put in place the standardized technology. It garantees that all manufacturers can get access to the market because they are sure that their product will be compatible with the electric vehicles or with the charging stations. Hence, many barriers to go to market, as well as uncertainty, are alleviated. It also means that the expense to develop the standard and the technology are beard by several entities. As a consequence, the competition between the stakeholders will be not on the framework and the laws, but on the quality of the innovation, the business model and the manufacturing skills. Indeed, the fact that many companies cooperate on the standardization does not mean they are not competitor on the market; on the contrary, their range of price and the quality of their charging station differ for the rest. There exists currently up to 50 charging station manufacturer using the CHAdeMO standard.



List (non exhaustive) of CHAdeMO charging stations produced by different manufacturer

(Final English brochure)

For instance, Fuji has launched the model Gen 3 DC quick charger, which is a low cost charging station with the standard CHAdeMO: the charger cost is of $25,000 (and 25kW of maximal power) compared to $40,000 for the regular CHAdeMO DC charger (50kW) for no more than 7 minutes of additional charging time. The cost of charging for a lower power is also half cheaper and will result in significant savings on the long run.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Costs | Gen 3 DC Quick charger | Other DC quick charger |  | Gen 3 DC Quick charger  (over 10 years) | Other DC quick charger (over 10 years) |
|  | 25 kW | 50 kW |  | 25 kW | 50 kW |
| Charger cost | $25,000 | $40,000 |  | $25,000 | $40,000 |
| Install Cost (wiring) | $20,000 | $20,000 |  | $20,000 | $20,000 |
| Install Cost (transformer) | $700 | $4,000 |  | $700 | $4,000 |
| Install Cost (Crane Rental) | $0 | $1,000 |  | $0 | $1,000 |
|  |  |  |  |  |  |
| Operating Cost (kWh) | Same | Same |  | Same | Same |
| Demand Cost ($28/kW) | $700 | $1,400 |  | $84,000 | $168,000 |
|  |  |  |  |  |  |
| Total |  |  |  | $129,700 | $233,00 |

Synergy between:

\_ automative manufacturers (Nissa, Mitsubishi, Toyota)

\_ electric utility (Tepco)

\_ battery and energy companies (NEC, Hitachi, Mitsubishi, Sumitomo)

Collaborative R&D among organisations

TEPCO R&D about e-mobility -> need of fast-charging stations to overcome range anxiety and support EV adoption

Consortium initiated to develop an international standard for fast charging stations

Important role of Japanese government : support of R&D projects

4 consortia in Japan from 2012: Japan Charge Network, CHAdeMO Charge Network, Nissan Leaf Zero Emissions Support, EVSS Network

Goal of the consortium: joint investment in infrastructure and network solutions; but competition for bids for government funding

With a common standard, the rest of the industry can focus on the business model.

The philosophy of CHAdeMO is that the success of the electric vehicles market rely on the success to overcome the range anxiety effect. By promoting

The risks

Currently, another standard for fast charging stations has emerged. Originating from BMW, Volkswagen and General Motors cooperation, the standard Combo has been accepted in the European Union as another official standard. For the moment, this does not raise problems of competition for the standard with CHAdeMO, as both are official standards, and the two plugs should be present on each public charging station. As most of the components are common, the extra cost for manufacturing a charging station that is compatible for the two standards does not exceed a raise of 5-10% (navigating the charging business). The European manufacturers were able to rapidly adapt and propose corresponding charging stations. The Tesla charging station will also be an actor.

The consequences are multiple. For the car manufacturers, they are thus not limited by the standards, and can only compete between electric vehicle performances. For the electric vehicle user, they could charge their vehicle at almost all charging station.

However, we can raise concern for the future. On the long run, will there be two standards or only one standard for charging stations? Nothing can indicate that there will be a reduction of standard, because it could lead to the destruction of a big share of the market.

Still, now, to stay a competitive standard, CHAdeMO will have to attract and retain car manufacturers and convince them to adopt their standard for the plug in the vehicle. As Combo proposes a unique plug for both AC and DC changing, the risk could be that the automotive industry focuses on the Combo technology, which could finish to phase out the interest of CHAdeMO standard and lead to its disappearance. Another argument to support this is that the most successful automative brands, like the German brands, focus on Combo standard. If the customer continue to buy cars from this brand, then the CHAdeMO standard would be in fact endangered and progressively out of market.

Another potential risk is the current difficulties of TEPCO because of Fukushima nuclear accident. This major actor has cut down its expenses on the research and development in the charging station domain, handicapping the progress of the standard.

Conclusion

\_ use of a standard to make every companies focus on R&D, business model -> increase of the competition in the areas that create value: many different charging stations with different price and business model

\_ use of a standard remove a barrier to competition

\_ the government has the power to set the rules of the market

\_ limit the expenses for useless development by mutualizing the investment for the standard, that let more capital for other activities

\_ at the same time, is there any risk for Japanese infrastructure ?...