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Docket Number:	16-TRAN-01
Project Title:	SB 350 Transportation Electrification (Publicly Owned Utilities)
TN #:	214657
Document Title:	Presentation -Trends of Autonomous Distribution System Integrated Control for Plug In Electric Vehicles
Description:	By John H. Holmes, 12/7/16
Filer:	Tami Haas
Organization:	UC San Diego Research Affairs
Submitter Role:	Public Agency
Submission Date:	12/7/2016 8:42:48 AM
Docketed Date:	12/7/2016

Trends of Autonomous Distribution System Integrated Control for Plug In Electric Vehicles

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CEC IEC 15118 Workshop

December 7, 2016

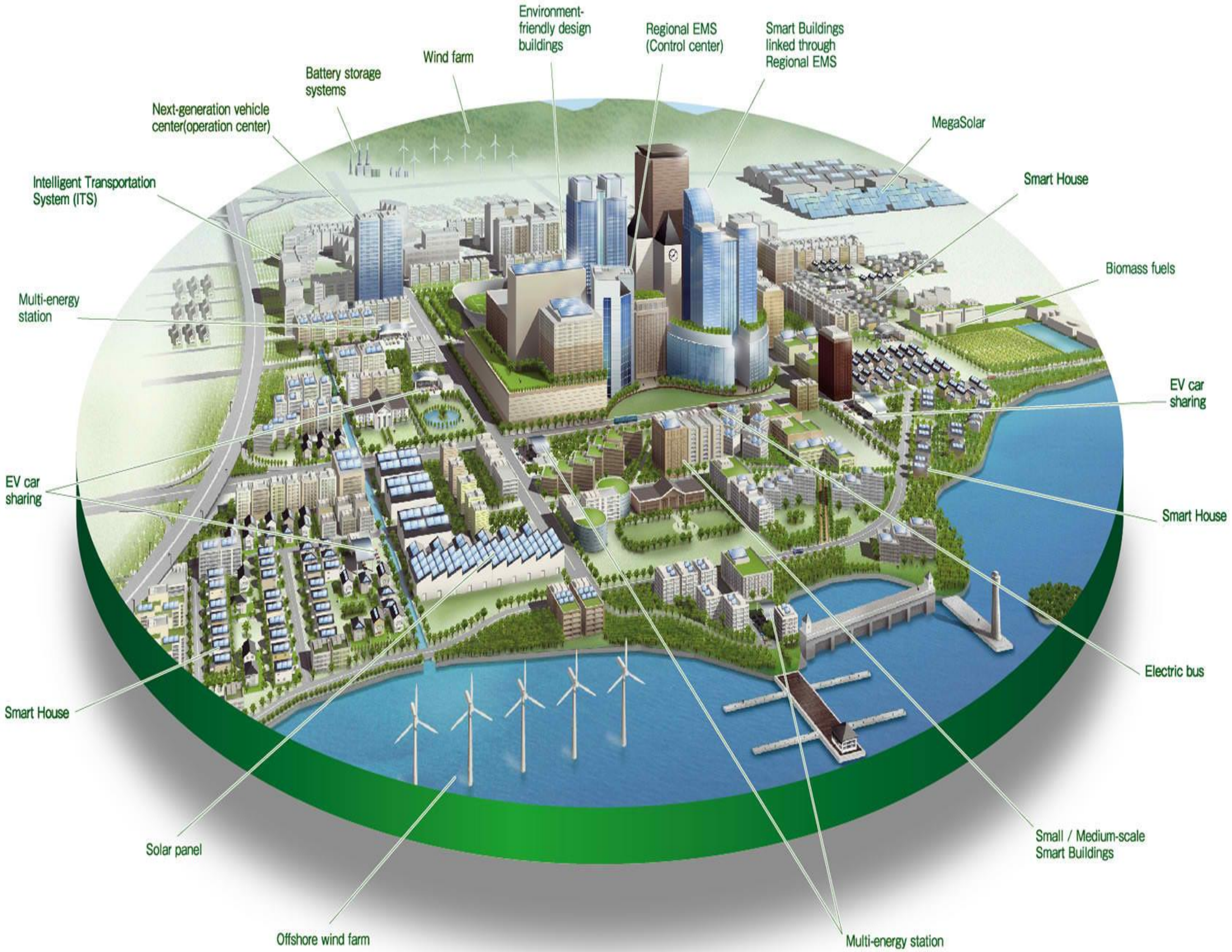
California’s future electricity system will consist of near zero net energy buildings, highly efficient businesses, low-carbon generation, sustainable bioenergy systems, more localized generation, and electrification of transportation, supported by a highly flexible and robust distribution and transmission infrastructure.

– California Energy Commission, EPIC Funding Vision

"The regulator has the job of strengthening competition and ensuring that this does not compromise security of supply and sustainability. To act even-handedly in the interests of all market participants, regulators must be politically and financially independent."

[E-Control, 2015]

Source: AIT



Environment-friendly design buildings
Regional EMS (Control center)
Smart Buildings linked through Regional EMS
Wind farm
Battery storage systems
Next-generation vehicle center(operation center)
MegaSolar
Smart House
Intelligent Transportation System (ITS)
Biomass fuels
Multi-energy station
EV car sharing
EV car sharing
Smart House
Electric bus
Smart House
Solar panel
Small / Medium-scale Smart Buildings
Offshore wind farm
Multi-energy station

The utility of the future
Flexibility, adaptability

Emerging technology market share will be significant by 2025

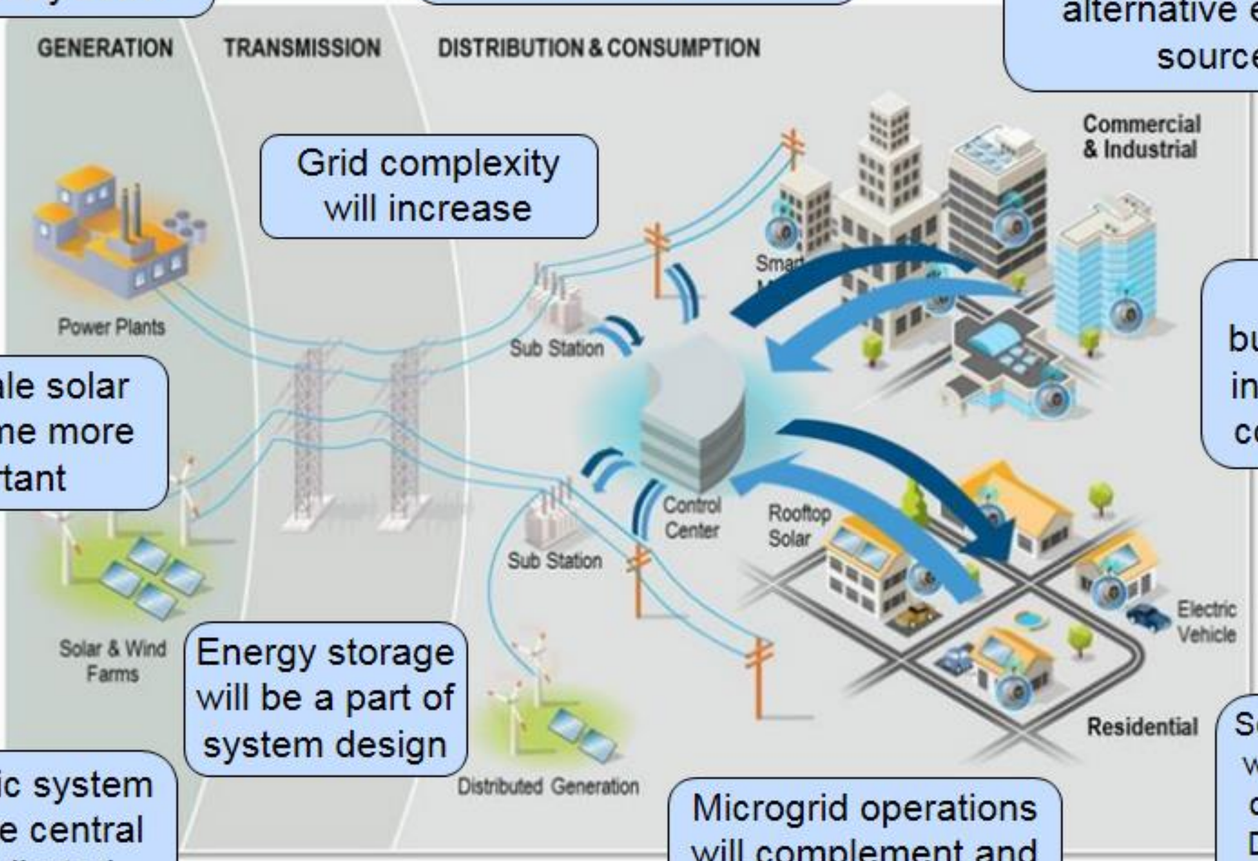
The grid will be the platform for the future electric system

Energy Efficiency is the most cost-effective alternative energy source

Grid complexity will increase

Utility scale solar will become more important

The electricity business model will include customized consumer services



Energy storage will be a part of system design

The electric system will include central and distributed generation

Microgrid operations will complement and compete with the grid

Some residential consumers will also become producers of energy; C&I markets for DER will have the greatest penetration in Texas

Picture Source: Trilliant

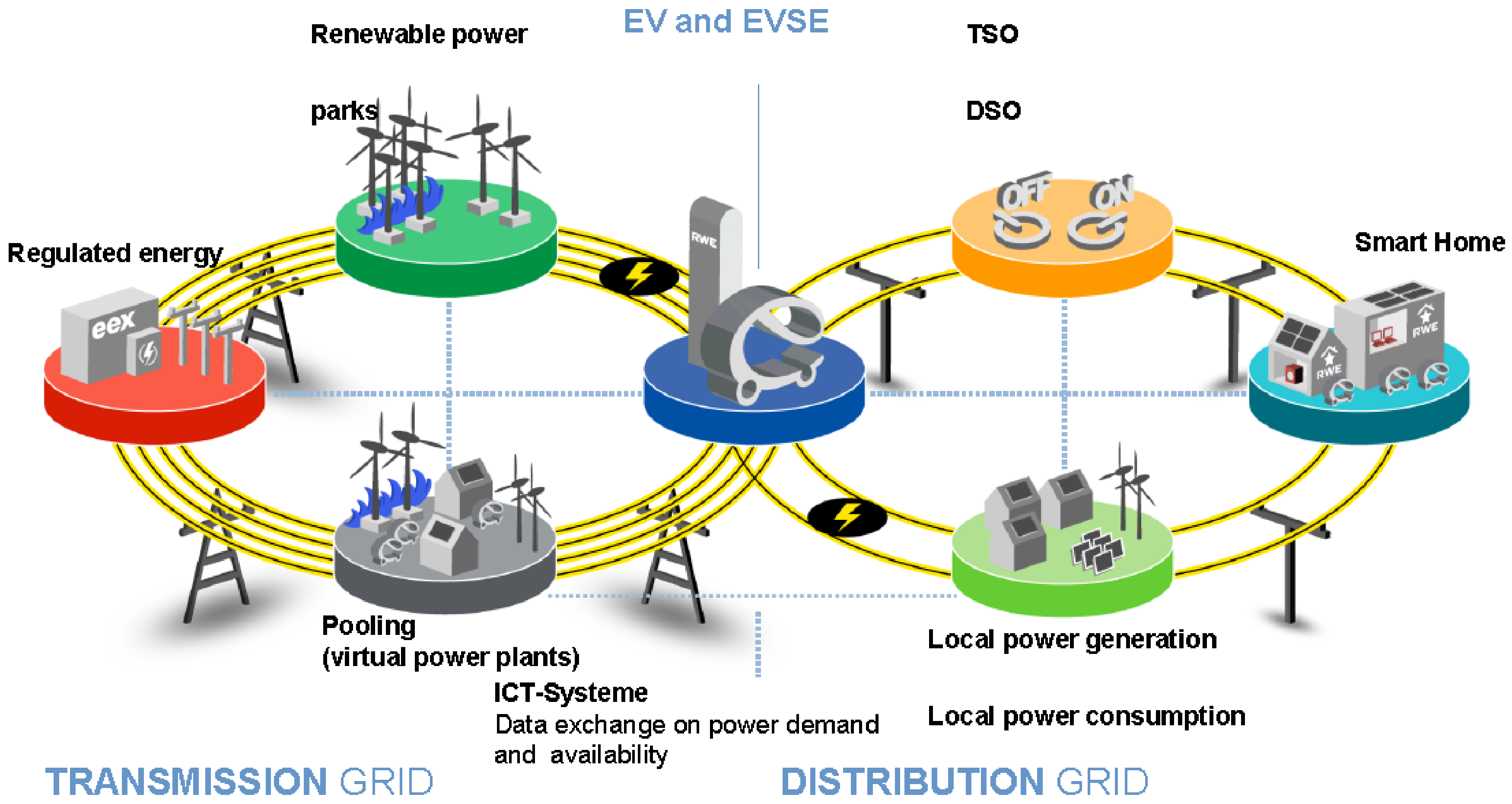
We have a clearly defined vision of the project

PlanGrid EV

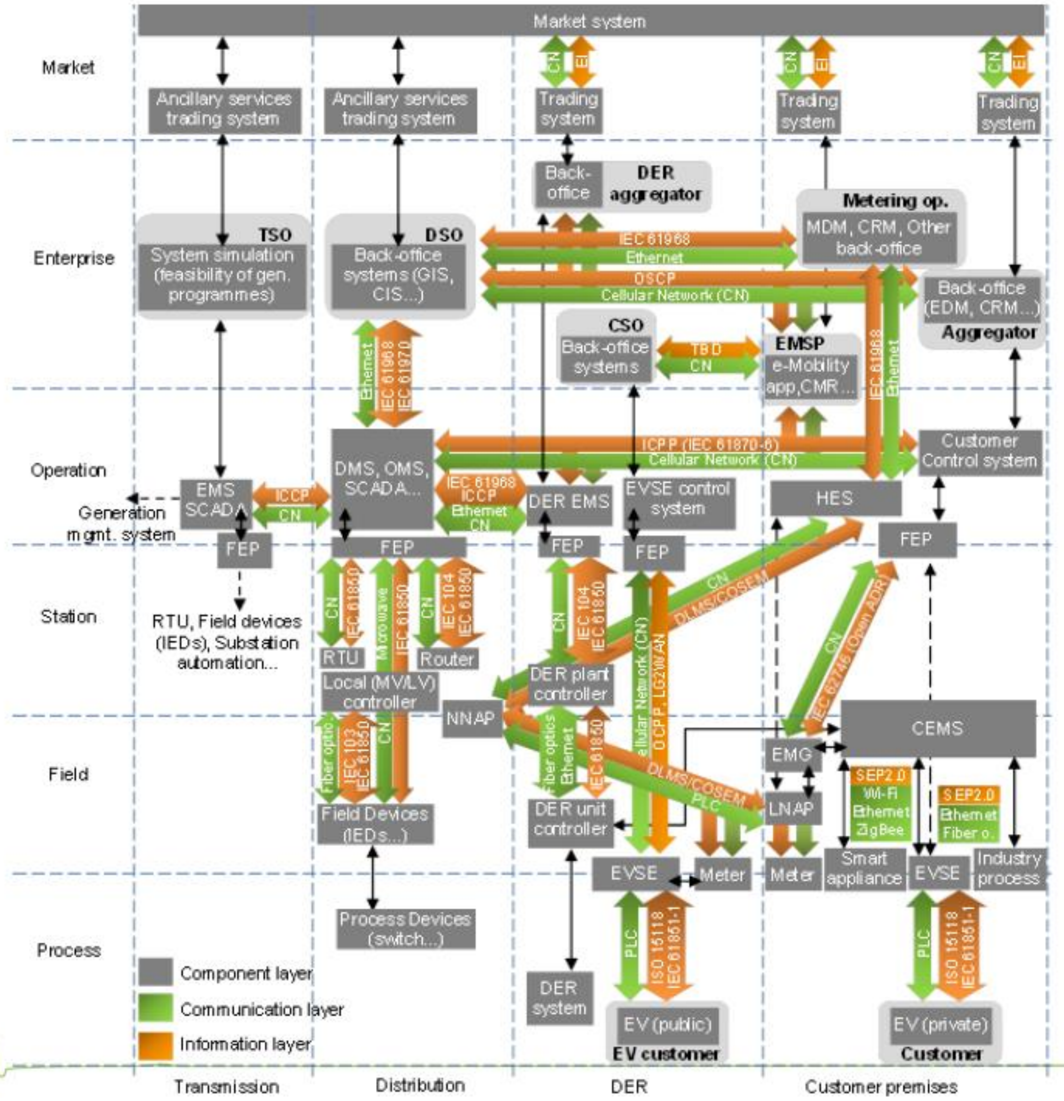
- We present the harmonized European approach for the future DSO electricity smart grid planning with an optimal EV integration, economically and technically justified, based on safe grid operation and DER balancing.
- The partners will work together taking a collaborative approach to benefit from each other's knowledge and expertise.

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement No. 608957.

Electro mobility will play a major role in the future Smart Grid activities.



Comprehensive ICT architecture proposal



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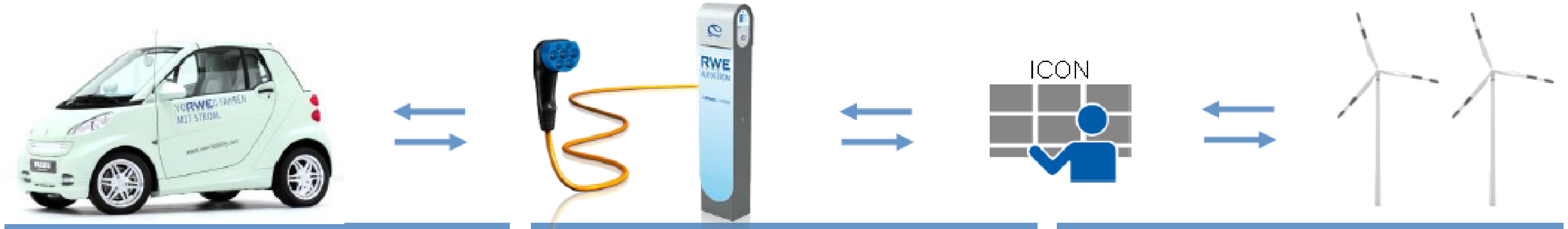
Source: RWE

Philosophy of ISO/IEC 15118

- Use Control Pilot (CP) and Pulse Width Modulation (PWM) of IEC 61851-1 (similar to SAE J1772) for "safety"
- Support of several services
- Authentication "External Identification Means" (EIM) and "Plug 'nd Charge" (PnC)
  - Handling of digital certificates and electronic signatures
- Charging AC (Alternating Current) and DC (Direct Current)
  - Respecting customer requirements
  - Allows respecting of availability of capacity and power at (distribution) grid
  - Allows respecting of price tables from energy reseller
  - (Re)Negotiation on new capacity and/or price profile table
- Value Added Services
- Respect security and privacy
- Provide enough bandwidth by using PLC technology based on HomePlug GreenPHY
- EV acts as a client, EVSE acts as a server

Smart electric cars, smart grids and charging stations will use a single data standard.

Advantages of the bidirectional communications protocol ISO/IEC 15118



Simplicity

- Automatic authentication at charging points
- Automatic contract handling operation (new contract, change of contract)
- Quick and easy foreign authentication (⇨ Enabling of Europe-wide e-roaming)
- High security against data manipulation

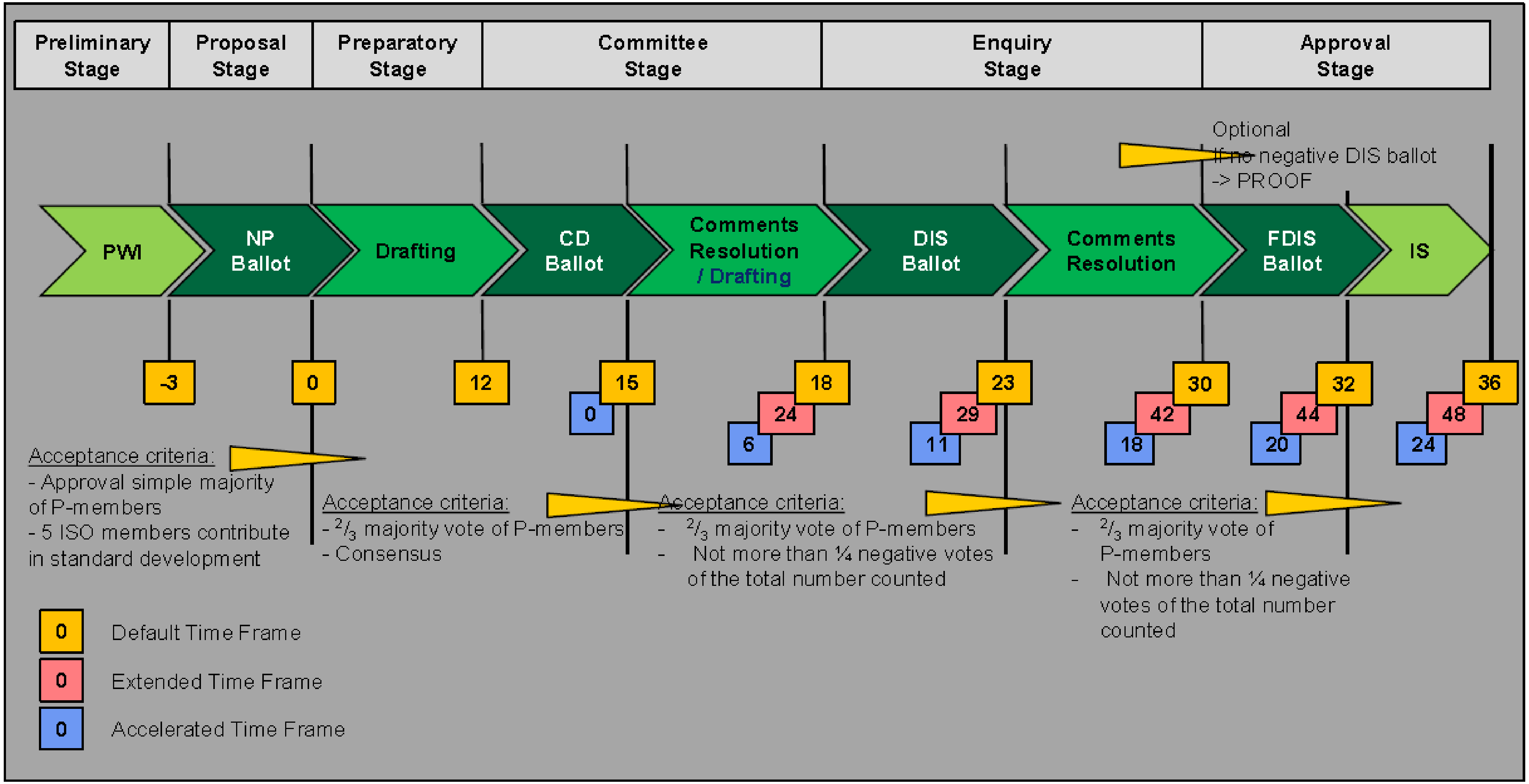
Grid friendliness

- Active load management through EV feedback
- Time-controlled charging possible
- Tariff-controlled charging possible
- Integration of renewable energy

International importance

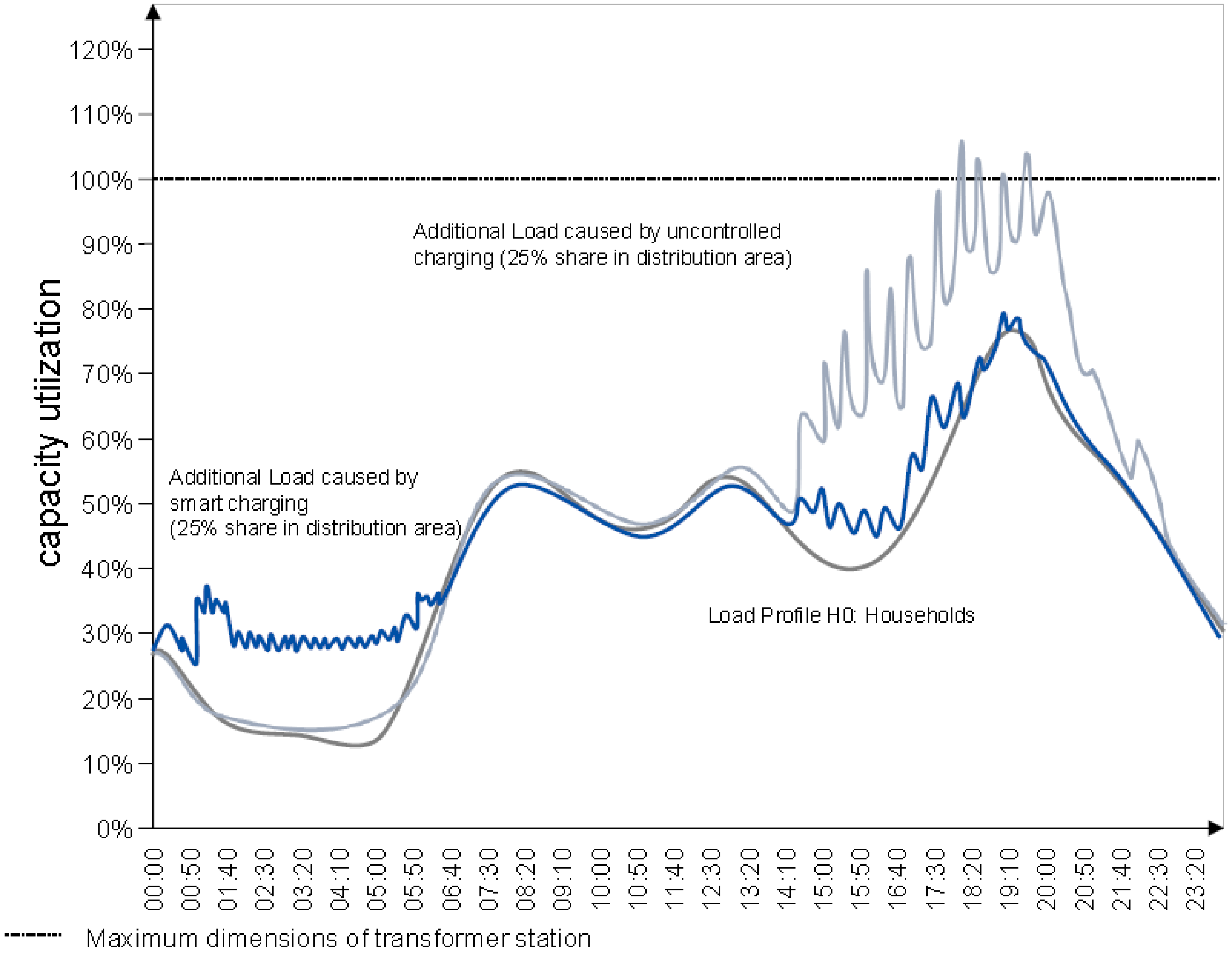
- European and American acceptance of the deployment for AC charging
- Worldwide acceptance for deployment for combined charging system (CCS) DC
- According to ACEA report of the OEM from 2017 integrated into all EVs

ISO Project Track (International Standard)



Smart Charging combines security of energy supply and customer convenience.

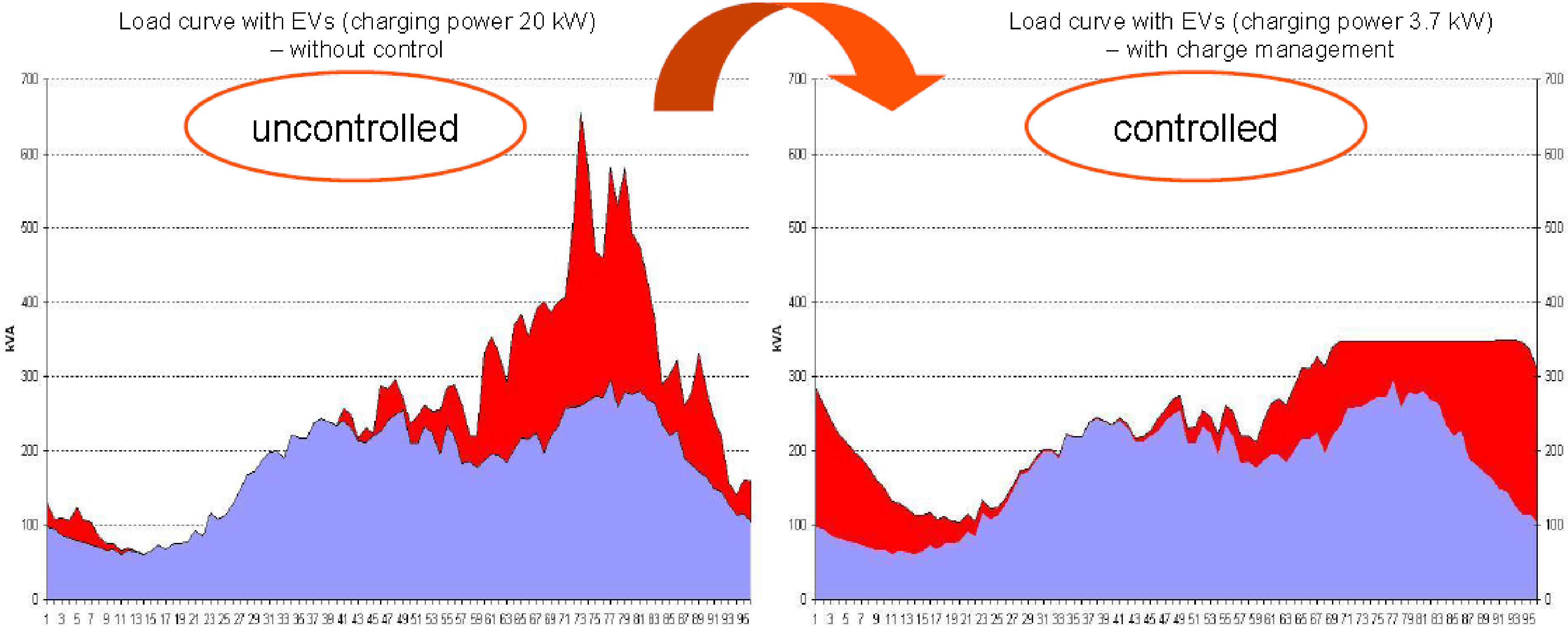
Effects of EV's and charging scenarios on the load curve



- Smart Charging limits the effects of additional loads on the distribution grid caused by EV's
- Overload situations can be avoided up to a high market share of EV's (~50%)
- Smart Charging offers the possibility to use the fluctuating generation of renewables
- No loss of convenience for the customer as the charging time is derived from customer preferences

RWE
The energy to lead

With target-oriented Management Grid Load can be reduced temporarily



With charge management a rate of 100% EV per household will be possible.

Source: Thomas Dederichs, IFHT-RWTH Aachen: "Elektrofahrzeuge als virtuelle Energiespeicher", BDEW-Fachtagung, Berlin, 14. Oktober 2010

ISO/IEC V2G CI PT structure

ISO/IEC Vehicle to Grid – Communication Interface

TC69
Paul Bertrand (for EDF)

TC22/SC3/JWG1
Michael Schwaiger (BMW)
Secretary: Eric Wern (VDA)

Layer

Layer	
7 Application	PT 1: Use-cases – Sven Jundel (RWE); PT 2; PT 5; PT 6
6 Presentation	PT 2; PT 5; PT 6
5 Session	PT 2; PT 3; PT 5; PT 6
4 Transport	PT 3; PT 5; PT 6
3 Network	PT 3; PT 5; PT 6
2 Data Link	PT 4; PT 5; PT 6
1 Physical	PT 4

PT 1: Use-cases
Sven Jundel (RWE)

PT 2: Messages, Sequences & Timing
Stephan Voit (RWE)

PT 3: Protocols
Andreas Heinrich, (Daimler)

PT 4: Communication technologies
Hervé Szychter (Renault)

PT 5: security analysis and measures
Sebastian Kaluza (BMW)

PT 6: Confor-mance Test
Jens Schmutzler (TU Dortmund)

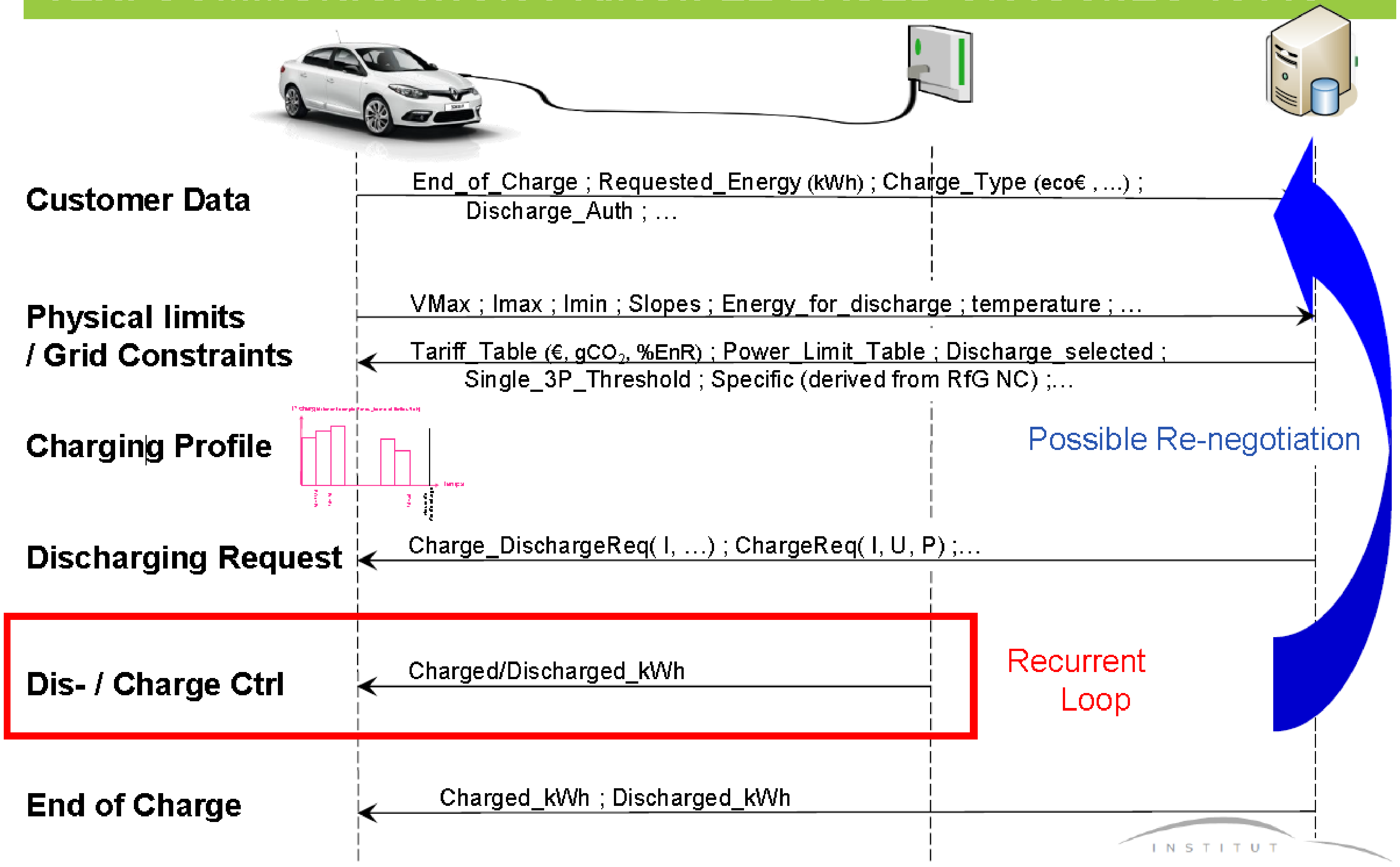
Wireless Communication is developed within Project Team (PT) 7.

Structure of Norm ISO/IEC 15118 „Road vehicles — Vehicle to grid communication interface"

- **Part 1**: General information and use-case definition (available as *International Standard* (IS) since April 2013)
- **Part 2**: Network and application protocol requirements (available as IS within next weeks)
- **Part 3**: Physical and data link layer requirements (available as *Final Draft International Standard* (FDIS) or *Committee Draft for Vote* (CDV) within next weeks)
- **Part 4**: Network and application protocol conformance test (*CD* available since 02/2014)
- **Part 5**: Physical layer and data link layer conformance test (*CD* available since 02/2014)
- **Part 6**: General information and use-case definition for wireless communication
- **Part 7**: Network and application protocol requirements for wireless communication
- **Part 8**: Physical layer and data link layer requirements for wireless communication

Availability: Paper or PDF versions of DIS, FDIS, CDV and IS can be bought at ISO (www.iso.org) and IEC (www.iec.ch). CD versions are only distributed within Joint Working Group.

V2X: COMMUNICATION PRINCIPLE BASED ON ISO/IEC 15118



TECHNICAL POINT OF VIEW

- **Communication between Charge Spot and EV could be ISO/IEC 15118 … but**
  - IMPROVEMENT REQUIRED FOR CHARGE ENVIRONMENT DISCOVERY (THRESHOLD BETWEEN SINGLE AND 3-PHASE, RULES FOR DISCHARGING, …)
  - QUESTION IN ORDER TO ADD 61850 & CIM DATA MODEL DEDICATED FOR GRID SERVICES
  - SERVICE PERFORMANCES ARE IMPLEMENTATION DEPENDENT

- **Communication interface with HEMS to be standardized**
  - LOTS OF PRIVATE PROTOCOLS
  - EXISTING PROTOCOLS NOT DEDICATED FOR "HARD" REAL TIME
  - PERFORMANCES ARE IMPLEMENTATION DEPENDENT
  - ISO/IEC 15118 / HOME PROTOCOL GATEWAY TO BE CAREFULLY IMPLEMENTED

- **EMS strategies**
  - INTEROPERABILITY REQUIRED

- **EV charge/discharge to be standardized**
  - IMPLEMENTATION OF V2X IS OFTEN BASED ON STATE MACHINE WHICH PREVENT TO OFFER QUICK RESPONSE TIME AND TO BE ACCURATE AROUND 0A.

Comprehensive Orchestration of Resources Supply, Storage & Demand

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