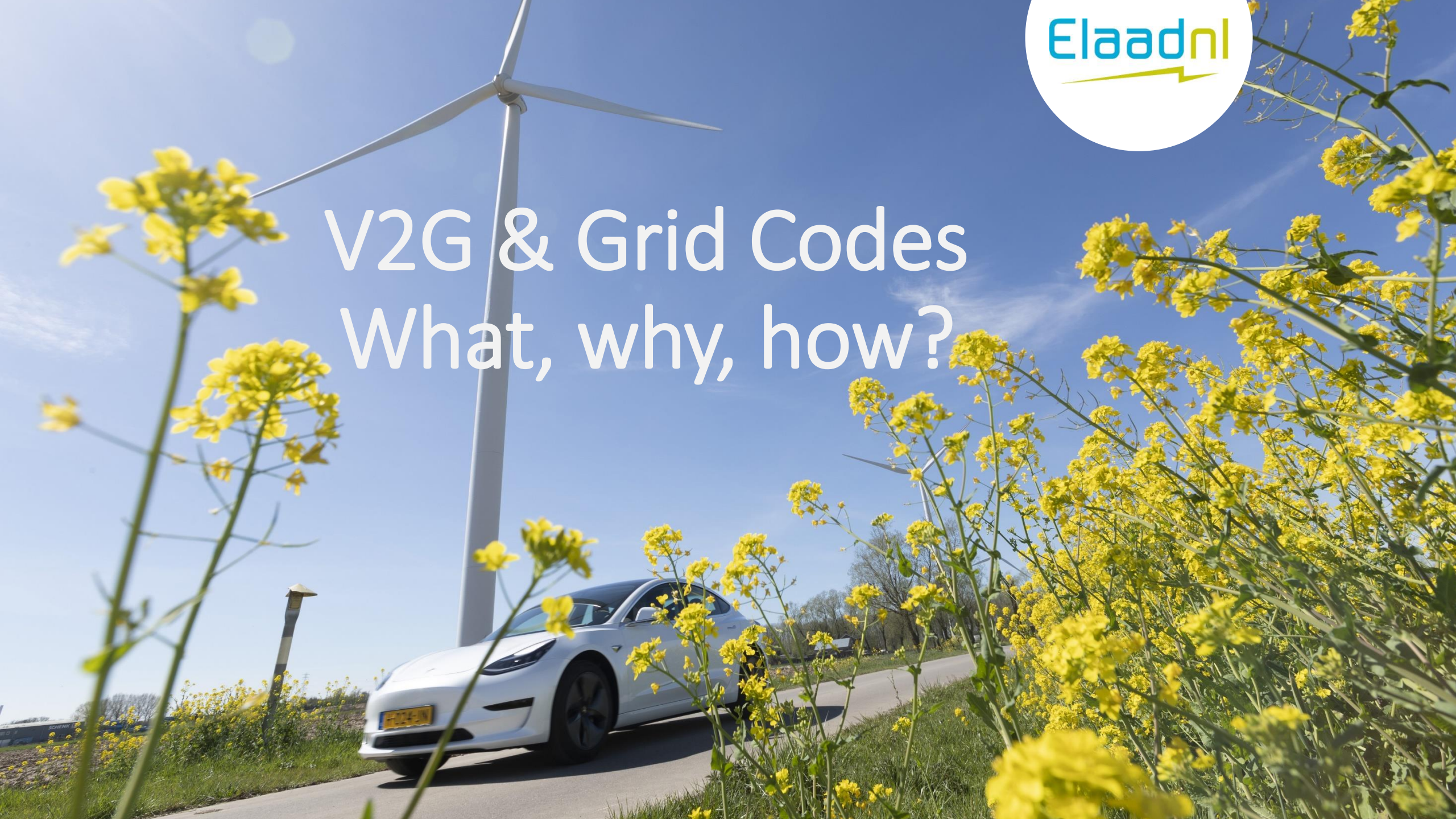
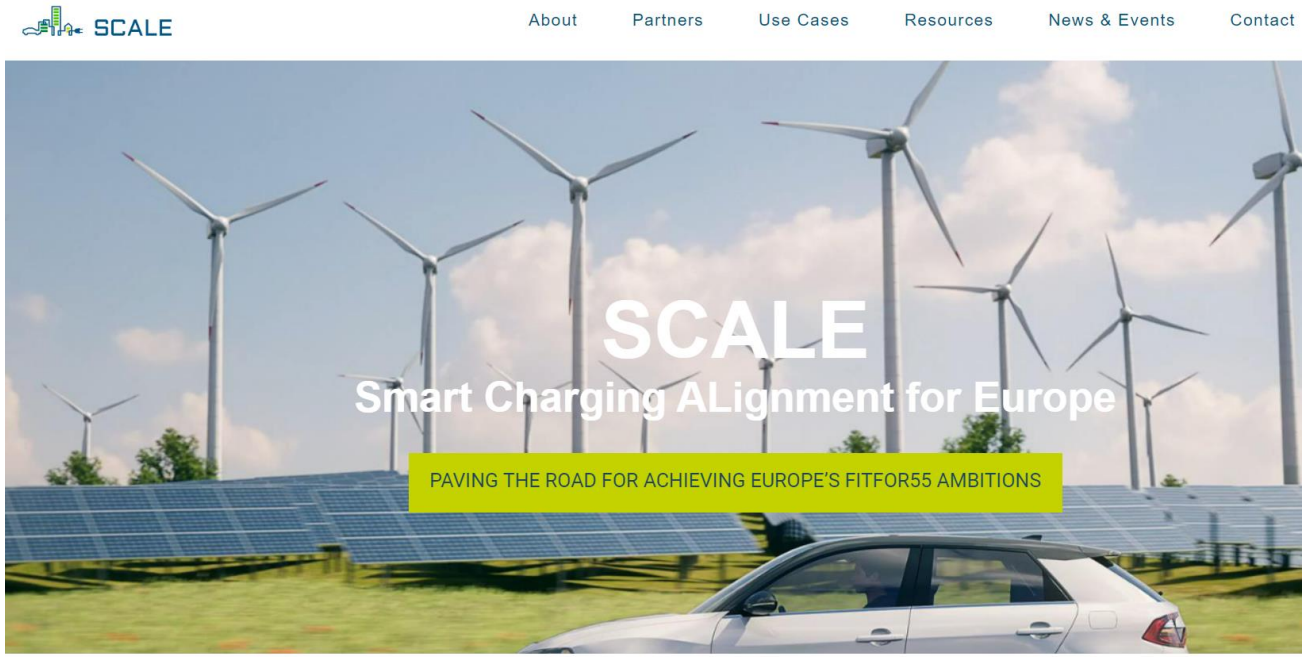


V2G & Grid Codes
What, why, how?


KLO

SCALE



EU Horizon project (2022-2025)

- France
- Germany
- Hungary
- Norway
- Sweden
- The Netherlands

- ➢ Assessment of TSO and DSO requirements for V2G
- ➢ Harmonization and education to advance V2G adoption

SCALE

Look out for the ‘Grid Codes & V2G’ publication this year

Explain what the Grid codes cover and why

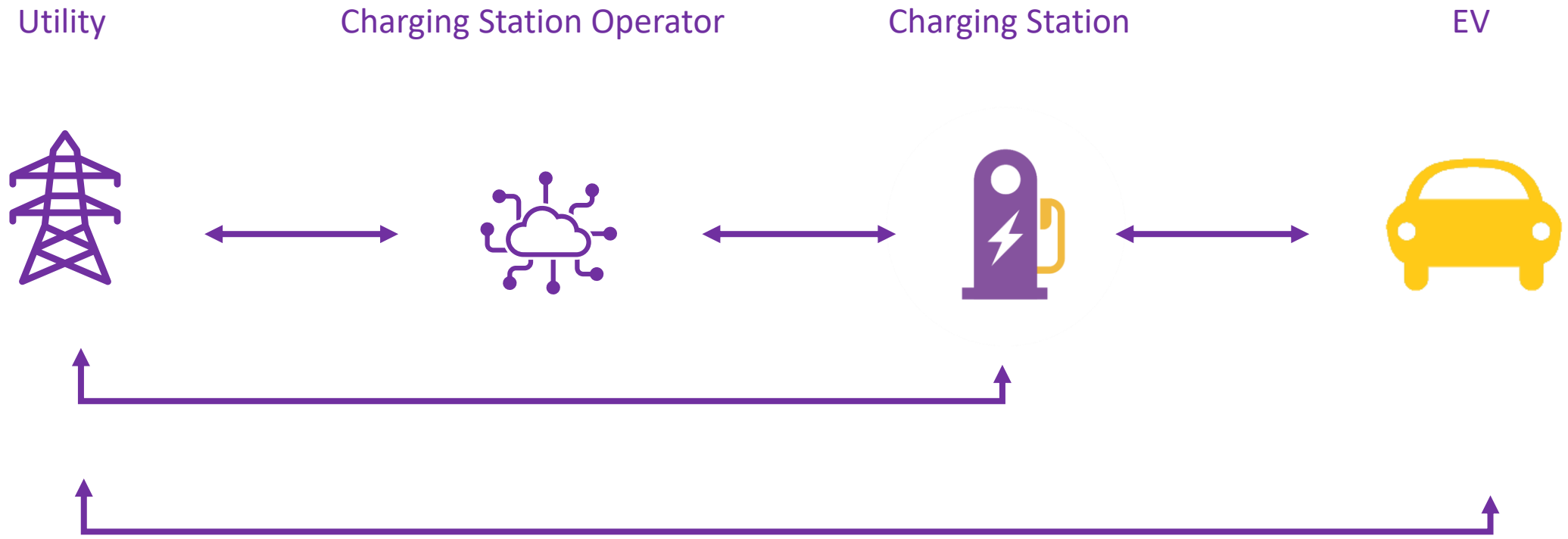
- Adjust behavior according to the grid frequency and voltage
- Listen to a direct ‘STOP!’ signal
- Continue operation despite grid ‘hick-ups’
- Detect if the grid is down: do not feed into the grid when it is down and when the grid comes back up, reconnect with care

Address France, Germany, Netherlands, USA

We are reaching out to more countries, such as Japan, Korea

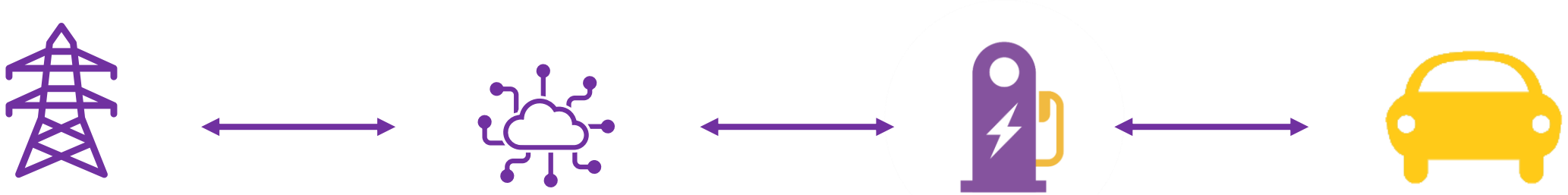
Standardize, build and test V2G fully compliant with the Grid Codes

Grid Codes and V2G - how



Grid Codes and V2G – what

Utility | Charging Station Operator | Charging Station | EV



IEEE 1547 - Standard for Interconnection and Interoperability of Distributed Energy Resources with associated Electric Power Systems Interfaces

EN 50549 - Requirements for generating plants to be connected in parallel with distribution networks

France
Netherlands
Germany

Grid Codes and V2G - how

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IEEE 1547

EN 50549

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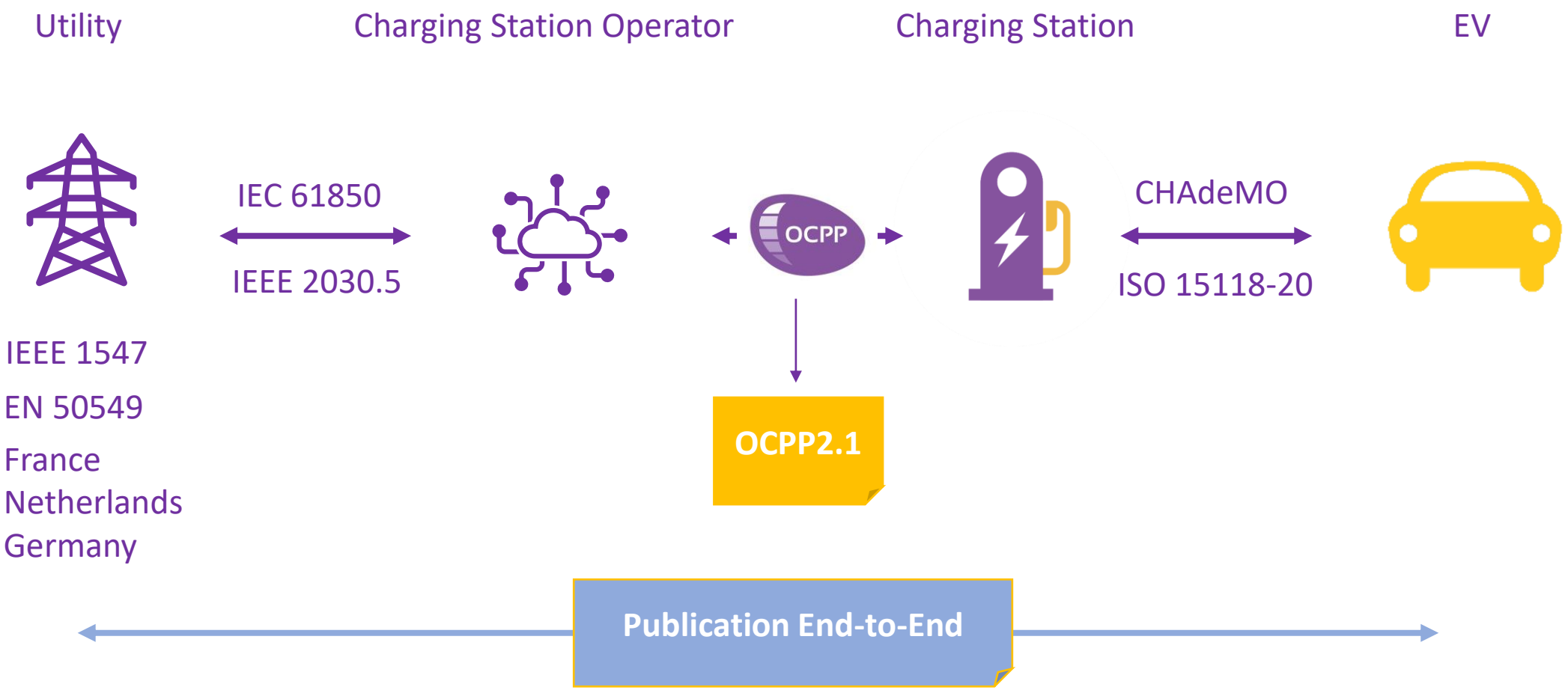
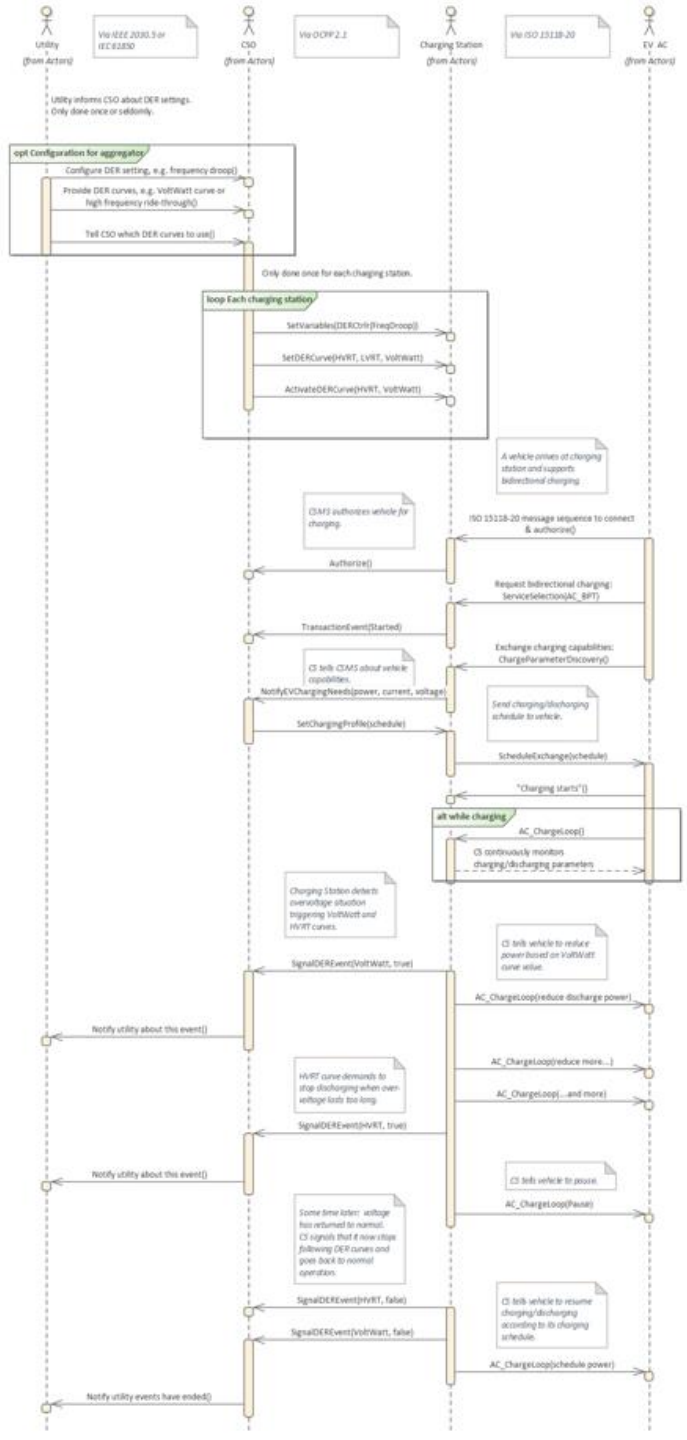
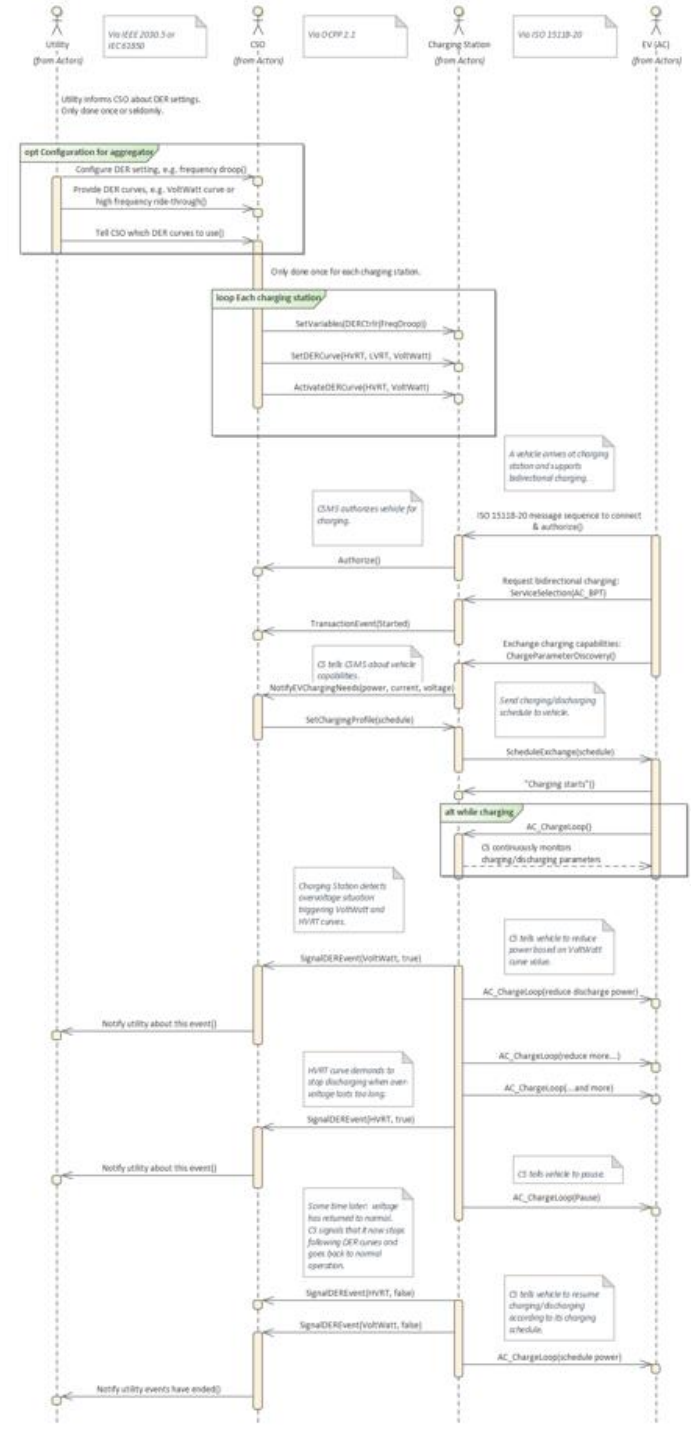
Grid Codes and V2G




Utility
(from Actors)
Via IEEE 2030.5 or IEC 61850
CSO
(from Actors)
Via OCPP 2.1
Charging Station
(from Actors)
Via ISO 15118-20
EV AC
(from Actors)
Utility informs CSO about DER settings.
Only done once or seldomly.
opt Configuration for aggregator
Configure DER setting, e.g. frequency droop()
Provide DER curves, e.g. VoltWatt curve or high frequency ride-through()
Tell CSO which DER curves to use()
Only done once for each charging station.
loop Each charging station
SetVariables(DERCtrl(FreqDroop))
SetDERCurve(HVRT, LVRT, VoltWatt)
ActivateDERCurve(HVRT, VoltWatt)
A vehicle arrives at charging station and supports bidirectional charging.
CSMS authorizes vehicle for charging.
ISO 15118-20 message sequence to connect & authorize()
Authorize()
Request bidirectional charging: ServiceSelection(AC_BPT)
TransactionEvent(Started)
Exchange charging capabilities: ChargeParameterDiscovery()
CS tells CSMS about vehicle capabilities.
NotifyEVChargingNeeds(power, current, voltage)
Send charging/discharging schedule to vehicle.
SetChargingProfile(schedule)
ScheduleExchange(schedule)
"Charging starts"()
alt while charging
AC_ChargeLoop()
CS continuously monitors charging/discharging parameters
Charging Station detects overvoltage situation triggering VoltWatt and HVRT curves.
CS tells vehicle to reduce power based on VoltWatt curve value.
SignalDEREvent(VoltWatt, true)
AC_ChargeLoop(reduce discharge power)
Notify utility about this event()
AC_ChargeLoop(reduce more...)
HVRT curve demands to stop discharging when over-voltage lasts too long.
AC_ChargeLoop(...and more)
SignalDEREvent(HVRT, true)
Notify utility about this event()
CS tells vehicle to pause.
AC_ChargeLoop(Pause)
Some time later: voltage has returned to normal. CS signals that it now stops following DER curves and goes back to normal operation.
SignalDEREvent(HVRT, false)
SignalDEREvent(VoltWatt, false)
CS tells vehicle to resume charging/discharging according to its charging schedule.
AC_ChargeLoop(schedule power)
Notify utility events have ended()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Notify utility events have ended()

Open Questions

Examples

Can there be multiple curves to follow or will a different curve that becomes active automatically terminate the previous one?

What shall CS do if multiple DER curves are active and conflicting?

- IEEE 2030.5 ref: 10.2.3.3: use most recent
- CSIP ref: 4.4.3: use most recent command
- California phase 3 DER reqs: 9.4.2: take lowest value

How often does a utility send settings and curves to a DER?

…….etc

Join us!