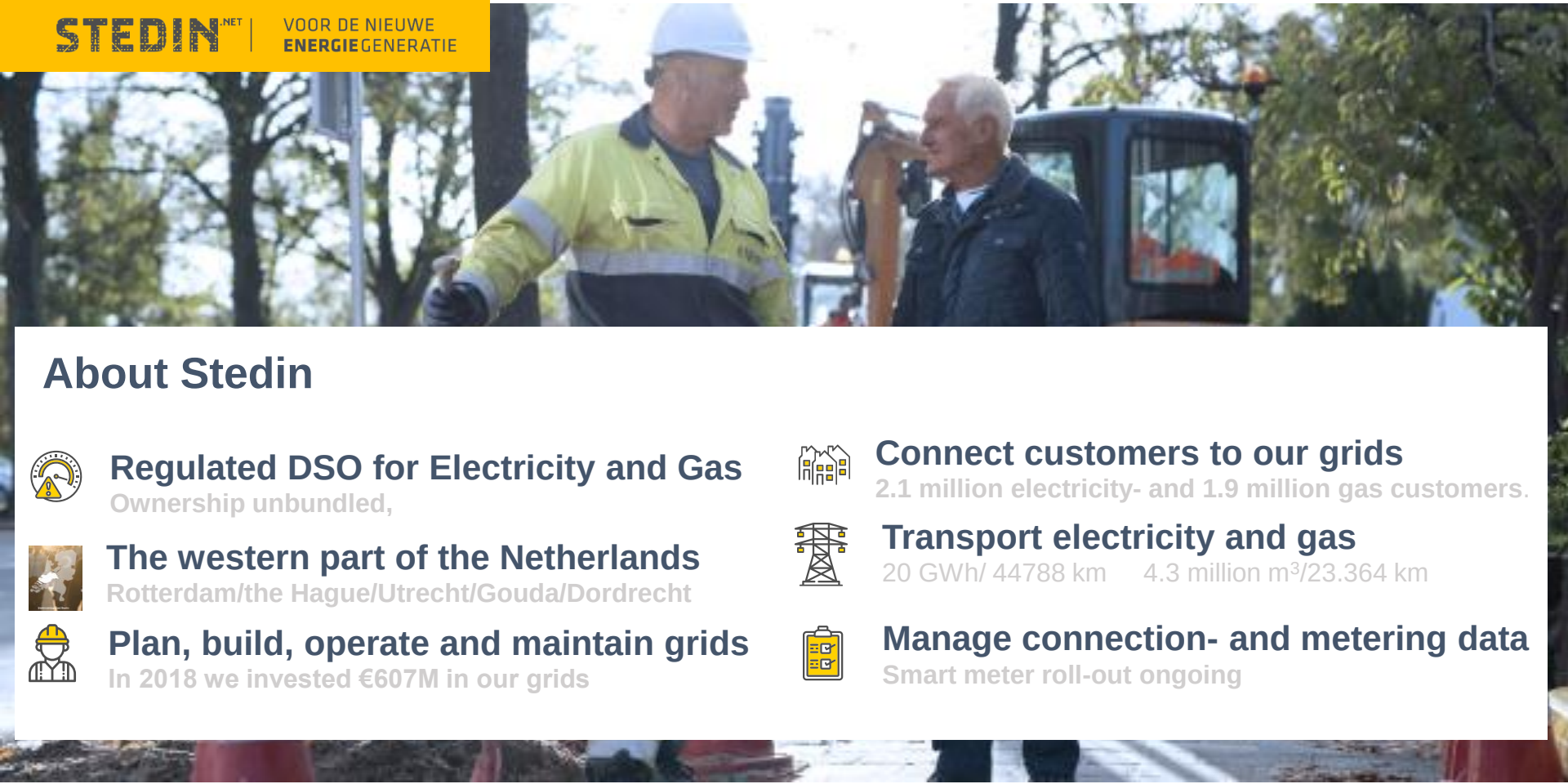
Time Series Analytics in Electricity Distribution System Operations: our experiences so far

Topics:

- Asset Lifecycle Management
- 61850 for PI
- Innovation Lab
- Network & System Operations



About Stedin

Regulated DSO for Electricity and Gas
Ownership unbundled,

The western part of the Netherlands
Rotterdam/the Hague/Utrecht/Gouda/Dordrecht

Plan, build, operate and maintain grids
In 2018 we invested €607M in our grids

Connect customers to our grids
2.1 million electricity- and 1.9 million gas customers.

Transport electricity and gas
20 GWh/ 44788 km 4.3 million m^3/23.364 km

Manage connection- and metering data
Smart meter roll-out ongoing

A snapshot of our innovation portfolio

Grid Operator Platform for Congestion Solutions (GOPACS)

Alternatives for natural gas

USEF

Solar

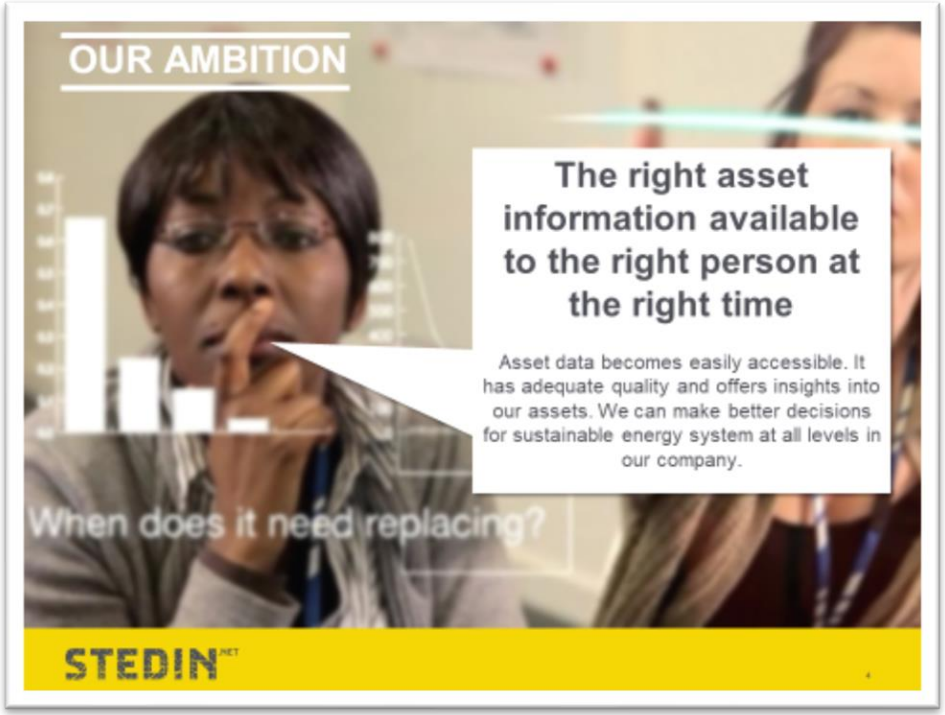
Energy trade with the blockchain

Smart EV Charging & Vehicle to Grid

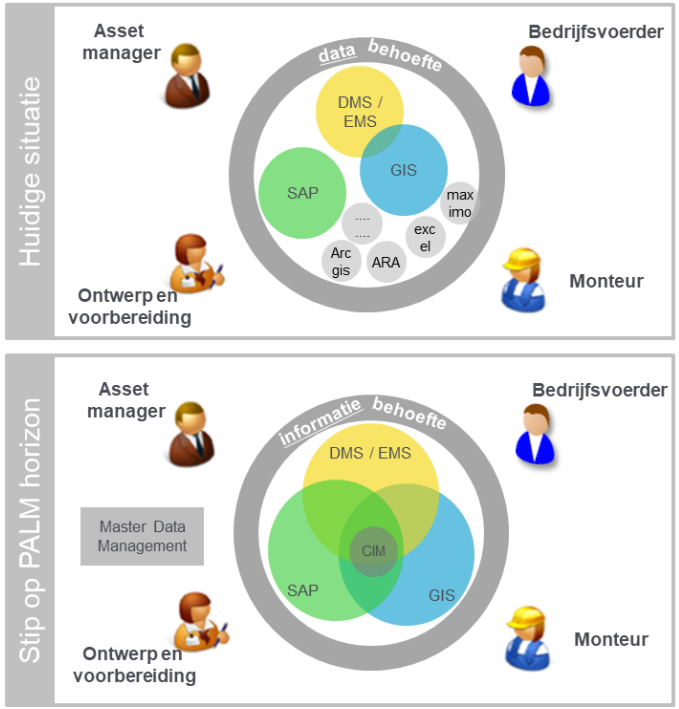
Hydrogen

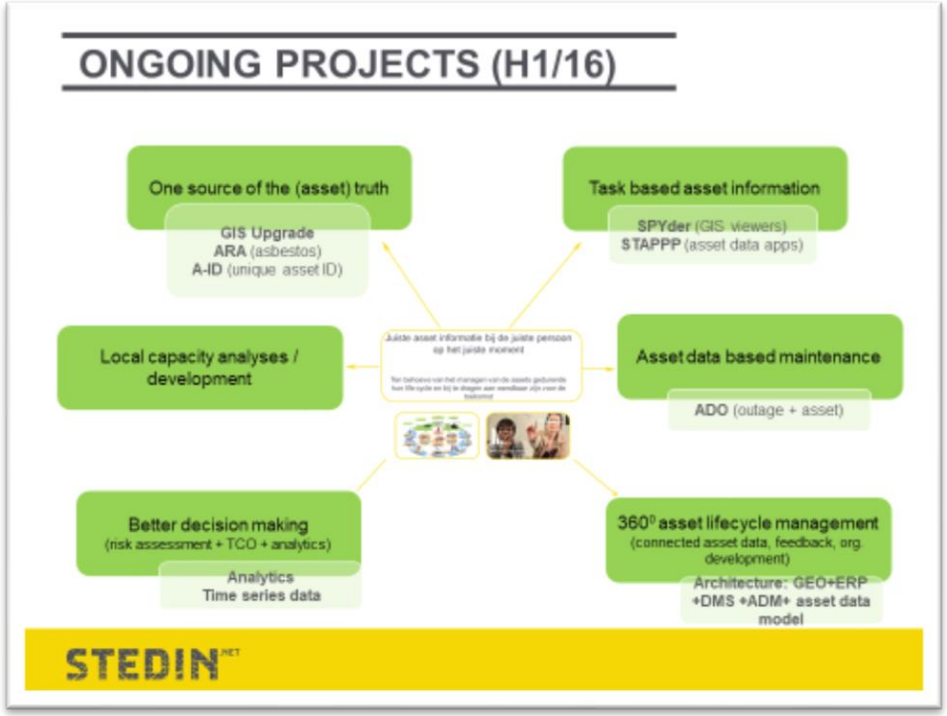
Flexibility solutions

Our journey with time series analytics started in 2016 as part of our Asset Lifecycle Management programme, PALM



PALM: an overhaul of our enterprise processes and IT/OT landscape



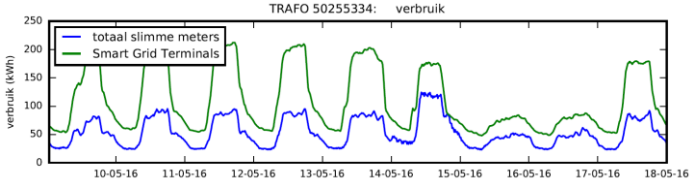


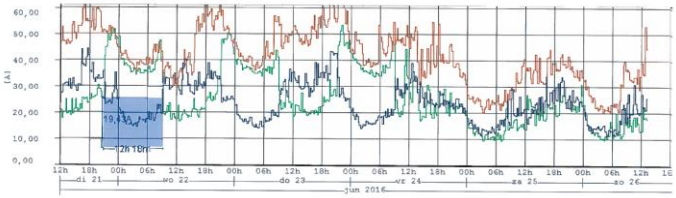
Analyics development, including Time Series

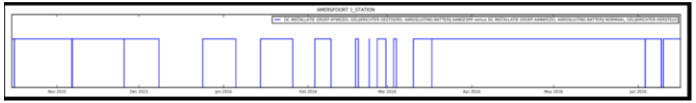
Evaluate 5 use cases in a PoC environment

Use Case	Source
LV capacity	Smart meters
	Distribution Transformer metering
Condition based maintenance	SCADA Events
Power quality	Distribution Transformer metering
	Field crew PQ meters
	PQ data from smart meters
	PQ meters
LV – interruption duration (CAIDI)	Smart Meter events
	Events from Distribution Transformer meters
MV capacity	SCADA metering data (SA-light, smart fault passage indicators)
	DER profiles
	Distribiution Transformer metering
	(Aggregated) smart metering data

STEDIN.NET





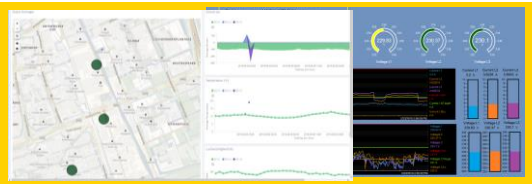


Stedin (OT) Innovation Lab - Enable continuous development on sensor streams and enable analytics

New devices

New use cases (on existing devices)

Unlock sensor feeds



Stedin (OT) Innovation Lab Results

Stedin en withthegrid installeren innovatieve corrosiesensoren

Rotterdam | 19-04-2018

Rotterdam 19 april 2018 - Stedin start een pilot met withthegrid, een startup die slir sensoren voor corrosiebewaking heeft ontwikkeld. Deze maand plaatst Stedin twin sensoren in haar gasnet. De sensoren meten de kwaliteit van de gasleidingen mee keren per dag of zelfs continu. Hierdoor hoeven monteurs geen controlemetingen verrichten en komt er meer tijd beschikbaar voor onderhoud en herstel. Alle data w gestructureerd opgeslagen en geanalyseerd in een platform.

Een deel van ons gasnet bestaat uit stalen leidingen waar een minieme elektrische spanı overheen staat, de zogeheten kathodische bescherming. Deze spanning beschermt de s

Stedin ontwikkelt nieuwe datatechniek voor haar elektriciteitsverdeelstations

Rotterdam | 06-12-2017

Stedin rust haar elektriciteitsverdeelstations uit met een innovatieve techniek waarmee gerichter onderhoud aan elektriciteitsverdeelstations kan worden gedaan. Het nieuwe systeem verzamelt data over de prestaties van de installaties in de stations en geeft dit real time door. Met die informatie kunnen we 24/7 de technische staat van onze stations monitoren. Hierdoor kunnen eventuele zwakheden eerder worden opgespoord zodat er gerichter preventief onderhoud kan plaatsvinden voordat een stroomstoring plaatsvindt.

Stedin werkt hierin samen met OSIsoft, een ontwikkelaar op het gebied van slimme software. De elektriciteitsverdeelstations zijn vergaand gedigitaliseerd, waardoor we het energienet goed kunnen monitoren. Met de nieuwe techniek kunnen we real-time en op afstand 'onder de motorkap kijken' in de stations en de data doorsturen naar monteurs. Het afgelopen jaar is de oplossing getest en geperfectioneerd. De komende jaren richten we meer stations in met deze apparatuur.

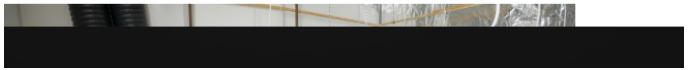
“ Stedin wil een betrouwbaar energienet voor haar klanten,

Stedin kan met slim gebruik elektriciteitsnet hennepkwekerij op afstand vinden

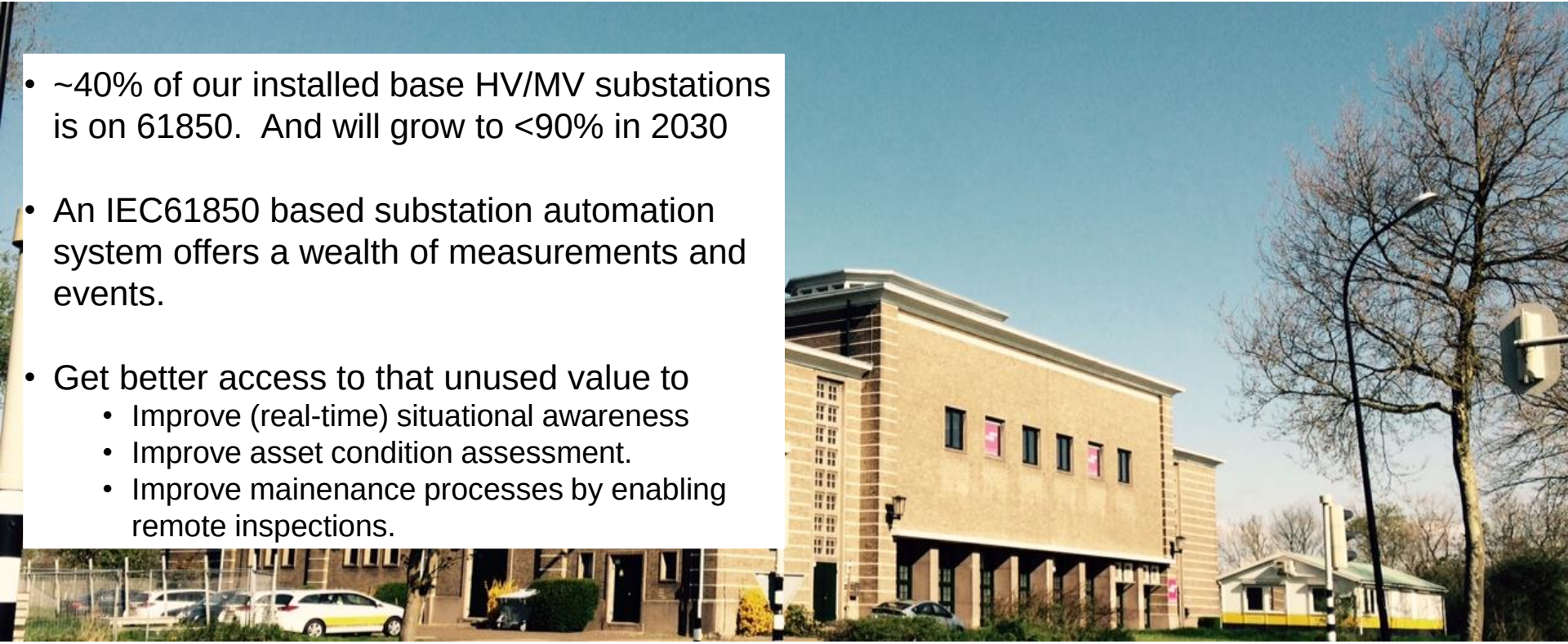
30-01-2016

Rotterdam, 30 januari 2016 – Netbeheerder Stedin heeft ontdekt dat illegale hennepkwekerijen op afstand te herkennen zijn in het elektriciteitsnet. Het Openbaar Ministerie, politie, gemeenten en de netbeheerder strijden al jaren gezamenlijk intensief tegen levensgevaarlijke situaties en energiefraude als gevolg van de kwekerijen. Met deze unieke ontdekking heeft Stedin een nieuw middel gevonden om energiediefstal en brandgevaarlijke situaties bij hennepkwekerijen op te sporen.

„We merken dat criminelen steeds innovatiever worden in het verbergen van hennepkwekerijen", zegt Stedin's hoofd fraudebestrijding Dave de Wit. „Bijvoorbeeld door ventilatie te maskeren is het voor de politie en ons steeds moeilijker illegale praktijken en gevaarlijke situaties op te sporen via bijvoorbeeld een warmtebeeldcamera. We kunnen daarom niet stilzitten. Door nieuwe digitale technieken toe te passen en slim gebruik te maken van ons energienetwerk verwachten we in 2016 nieuwe stappen te maken in de bestrijding van energiefraude."

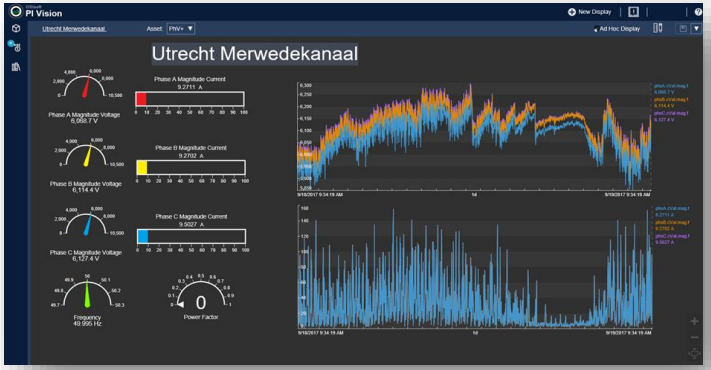


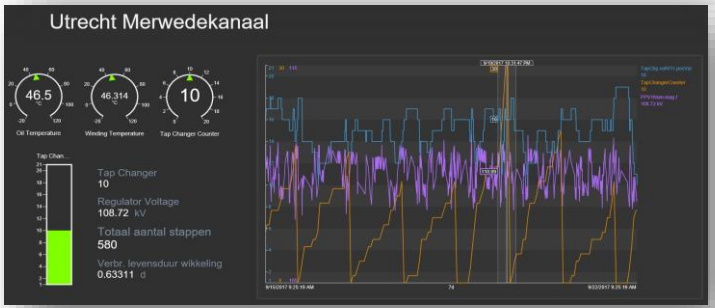
61850 for PI: Getting better access to OT data in substations



- ~40% of our installed base HV/MV substations is on 61850. And will grow to <90% in 2030
- An IEC61850 based substation automation system offers a wealth of measurements and events.
- Get better access to that unused value to
  - Improve (real-time) situational awareness
  - Improve asset condition assessment.
  - Improve mainenance processes by enabling remote inspections.

61850 for PI: how does it work?





OSIsoft Launches PI Connector for IEC 61850

12/05/2017

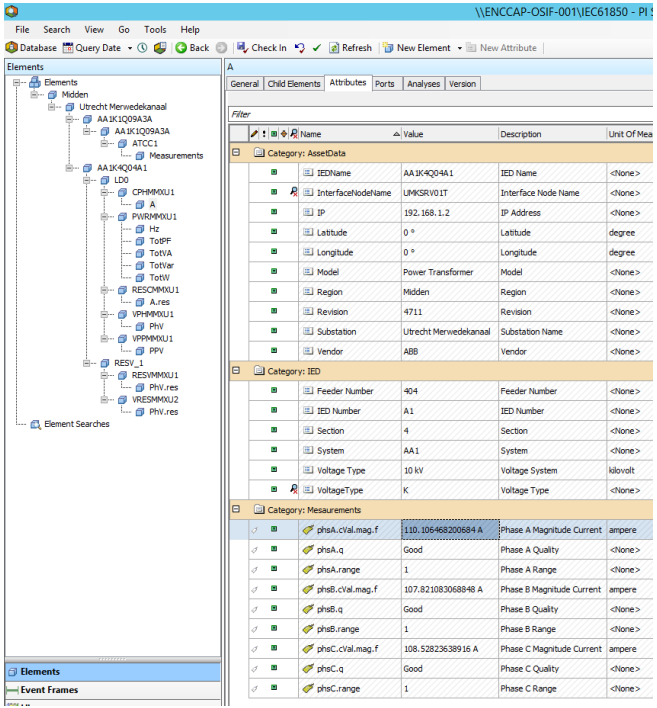
Distribution System Operator Stedin collaborated on new software and is adopting it as part of its retrofit of 185 substations

San Leandro, CA (Dec XX, 2017) OSIsoft LLC, a leader in operational intelligence, unveiled the PI Connector for IEC 61850 this week, a software interface designed to help utilities, grid operators and large power users to pave the way for digital transformation.

The PI Connector for IEC 61850 reads and automatically contextualizes data from IEC 61850-based devices such as transformers and switchgear so that it can be quickly integrated to the enterprise-wide system of record managed by the PI System. The connector effectively simplifies the process for adding new devices and sources of data to grids and other operational networks, thereby lowering the cost and time required to implement initiatives like remote diagnostics and predictive maintenance while increasing performance and visibility. (IEC 61850 is a networking standard for substation automation equipment. The market for IEC 61850-complaint equipment grows at approximately 18% per year.)

Stedin, a distribution system operator serving approximately two million residential and commercial customers in the Netherlands, is retrofitting its 185 substations around the IEC 61850 standard. In 2011, Stedin developed a vision to digitize grid operations in order to improve efficiency and quality of grid operations as well as anticipate market trends and regulatory drivers. Today, around 60 substations are fully IEC 61850 based and each year 15 to 20 substations will be refurbished for IEC 61850. In 2017, Stedin and OSIsoft began to collaborate on the PI Connector for IEC 61850 and recently finalized the specifications after testing in Stedin facilities.

61850 for PI: how does it work ?



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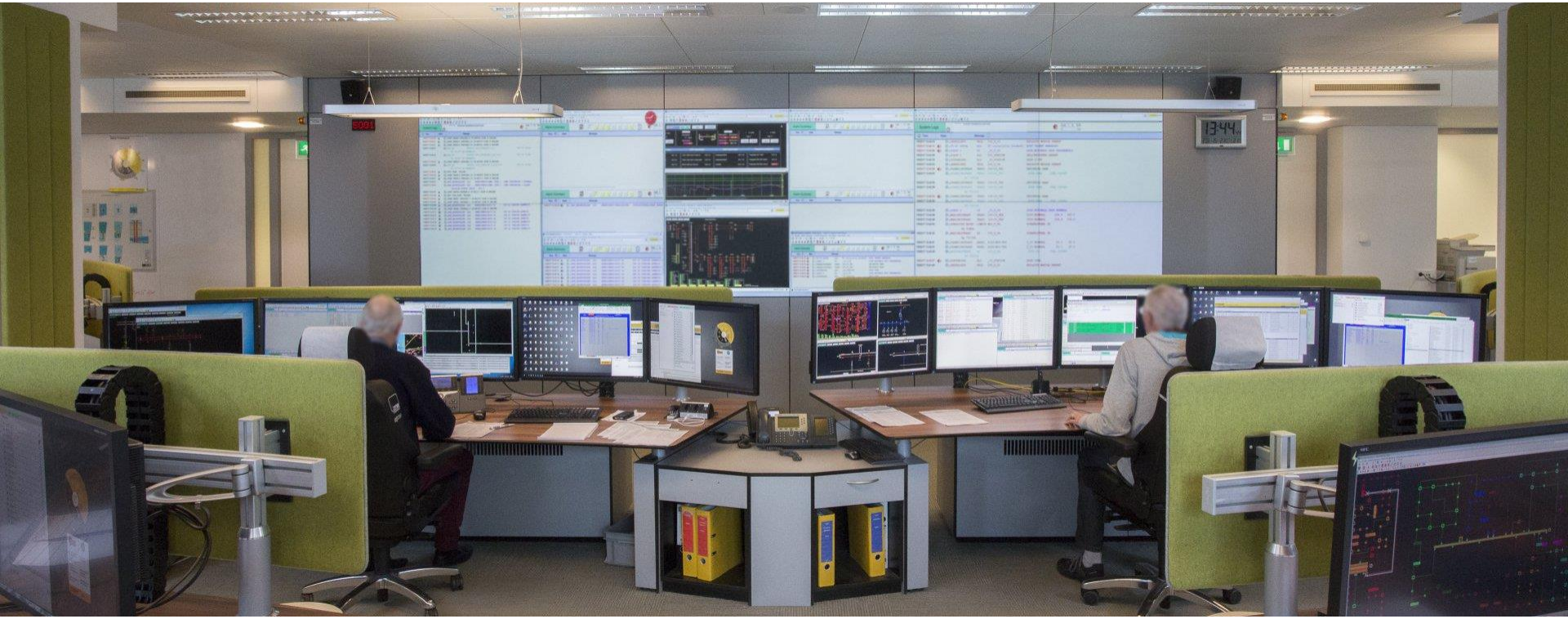
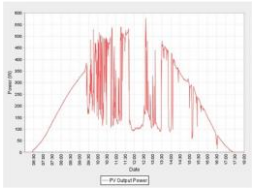
Network- and System Operations

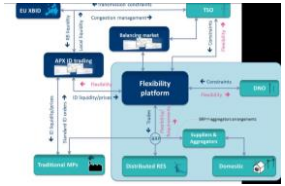


DER's impact day-to-day Network and System Operations

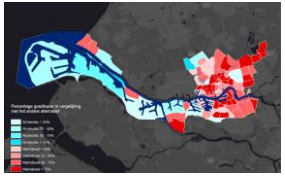
Less predictable power flows,
Power quality issues,
Loss of ineratia



Short term congestion
Long term congestion
Flexibility services



System-wide and Local bottlenecks
System-wide and local solutons
TSO /DSO / market coordination



From Network Operation to System Operations

PHASE 1

Safe and Reliable Grid Operations

Running the ‘Copper plate’

PHASE 2

Use the system ‘ to the max’

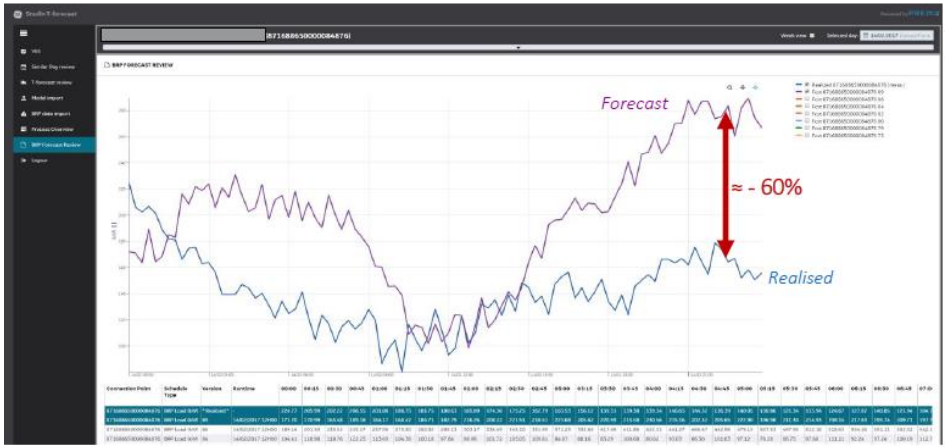
Operate the system as efficiently as possible. Give insight and use available capacity fairly and deal with congestion.

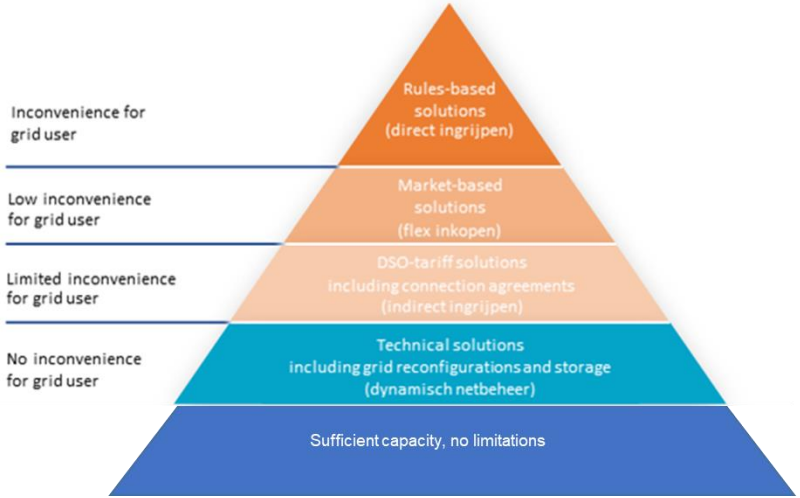
PHASE 3

Grow the system smartly

Grow system capacity in a smart way by using active network management and non-firm grid connections.

Getting forecasts as accurately as possible + Getting a new toolbox into place





This affects our core network/system operations processes, in all time domains and in all network levels.

STEP 1

Safe and Reliable Grid Operations

STEP 2

System Optimisation

STEP 3

Expand 'beyond the copper plate'

	Control ('NOW')			Plan & Anticipate		Optimise	
	Real-time	Near real-time	Dag	Week	Maand	Jaar	>Jaar
High Voltage	1, 24	2, 3, 4, 5a, 7a, 22, 23	5b, 6, 22, 23	7b, 8, 22	10, 11, 13, 22	12, 13, 14, 20, 21	15, 16, 17, 19
Medium Voltage	1, 24	2, 4, 22, 23	22, 23	7, 22	10, 11, 12, 22	12, 13, 14, 20, 21	15, 16, 17, 19
Low Voltage	24	4, 22, 23	22, 23	7, 22	9, 10, 12, 22	13, 14, 20, 21	15, 16, 17, 19

Today, we do congestion management and transport forecasting

Transportprognoses

Transportprognoses (ook wel T-prognoses of T-programma's genoemd) zijn een verwachting van het benodigde transport voor de levering of productie van elektriciteit. Van uur tot uur laten de transportprognoses zien wat de gevraagde transporten zijn over de aansluitingen op het net.

Die informatie is afkomstig van producenten van elektriciteit, regionale netbeheerders en grootverbruikers. Stedin stelt zelf ook per regio (zie kaart) transportprognoses op en verstuurt deze naar andere (bovenliggende) netbeheerders.

Bekijk transportprognoses

Nut van Transportprognoses

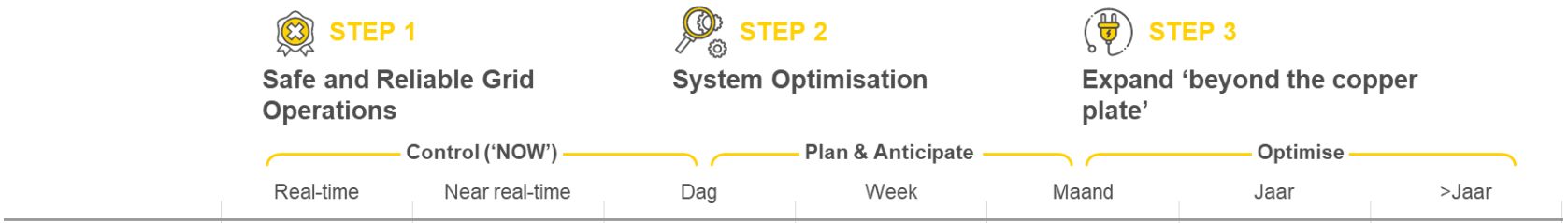
Transportprognoses benaderen de werkelijkheid zo goed als mogelijk is. Het geeft inzicht in de gevraagde transportcapaciteit en de verwachte belasting van het net. Dat is een belangrijk middel om verstoringen en

Wat is congestie?

Congestie is vergelijkbaar met filevorming op een snelweg. Afgelopen jaren is in een aantal regio's in Nederland een snelgroeiende vraag naar transportcapaciteit ontstaan. Enerzijds door de productie van elektriciteit en anderzijds door de toename in het verbruik. Om producenten van elektriciteit op het elektriciteitsnet aan te sluiten, moeten we het net uitbreiden of verzwaren. Stedin investeert fors in structurele netuitbreidingen, die vanwege zorgvuldige procedures een aantal jaren

datum	06-09-19		07-09-19		08-09-19		09-09-19		10-09-19		11-09-19		12-09-19	
tijd	prognose	realisatie	prognose	realisatie	prognose	realisatie	prognose	realisatie	prognose	realisatie	prognose	realisatie	prognose	realisatie
00:00	-681	-608	-628	-595	-634	-585	-545	-570	-595	-599	-584	-562	-596	-620
00:15	-667	-596	-635	-587	-631	-577	-547	-560	-605	-583	-574	-552	-580	-607
00:30	-643	-582	-633	-579	-617	-566	-550	-548	-589	-571	-553	-538	-564	-597
00:45	-628	-569	-622	-571	-607	-560	-545	-540	-577	-555	-541	-529	-554	-586
01:00	-630	-561	-633	-563	-613	-551	-585	-539	-577	-548	-543	-524	-549	-575
01:15	-626	-556	-631	-557	-610	-548	-572	-534	-570	-541	-538	-519	-542	-572
01:30	-619	-548	-602	-545	-602	-539	-570	-528	-584	-535	-532	-508	-529	-583
01:45	-616	-536	-591	-537	-591	-528	-571	-521	-558	-526	-526	-498	-525	-557
02:00	-623	-545	-596	-545	-594	-531	-585	-535	-576	-540	-542	-510	-541	-568
02:15	-622	-554	-600	-552	-599	-536	-593	-547	-580	-548	-548	-522	-549	-574

Need for business process change



- Intraday, day ahead & long term capacity forecast
- More visibility into the grid, more sensoring
- Exchanging data with TSO and DER's according to (European) grid codes.
- Operational Processes for congestion management, including TSO/DSO/market coordination and direct (DER) Control, also according to grid codes
- Advanced network planning & communication of (possible) congestion area's

Technical solutions for system operations/ system coordination are not new. OSI has references in this area

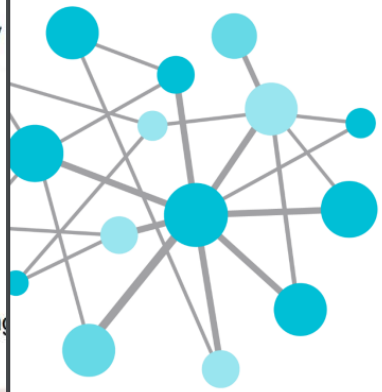
What is coreso ?

Coreso: a service provider to TSOs

- **Coordination services** (to shareholders)
  - Relaying significant information between TSOs
  - Pro-active assessment of the security level of the network (day close to real time forecast)
  - Proposing coordinated actions to TSOs to manage the risks
  - Coordinating the agreement on remedial actions
  - Contributing to ex-post analysis and experience reviews of significant operating events for the appropriate area
- **Data/IT management** (to TSOs of the CWE area)
  - Merging of D-2 files for the Market Coupling
  - Hosting of the common system of TSOs for the Market Couplin

Operational decisions remain with the TSOs

OSIsoft. USERS CONFERENCE 2013



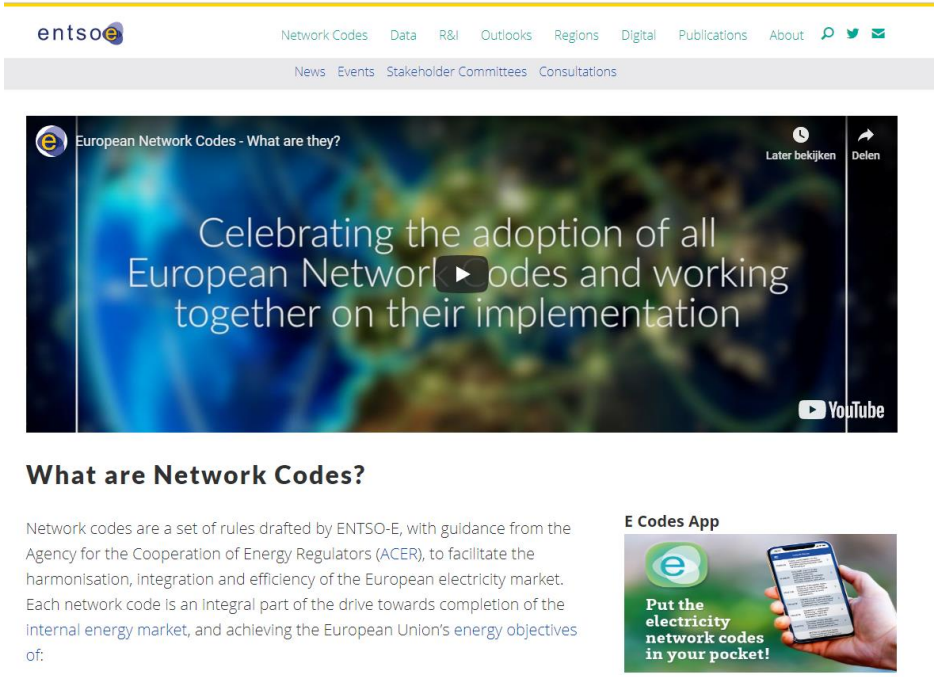
CAISO (California Independent System Operator) Challenges and Solutions

Presented by **Brian Cummins – Manager, CAISO**

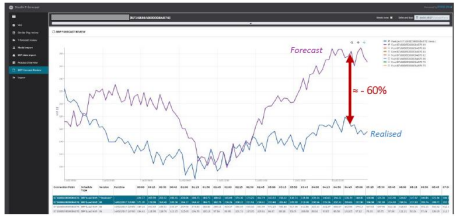
California ISO
Shaping a Renewed Future

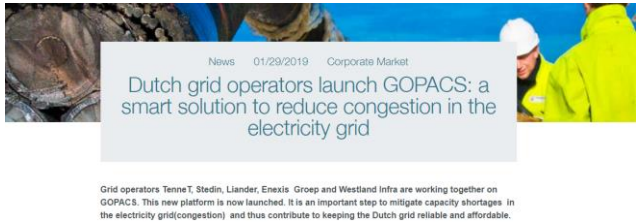
OSIsoft. INDUSTRY SEMINAR 2014

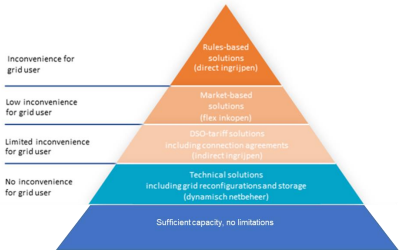
But not that many that fit in the European TSO/DSO market model and in the context of the new European network codes

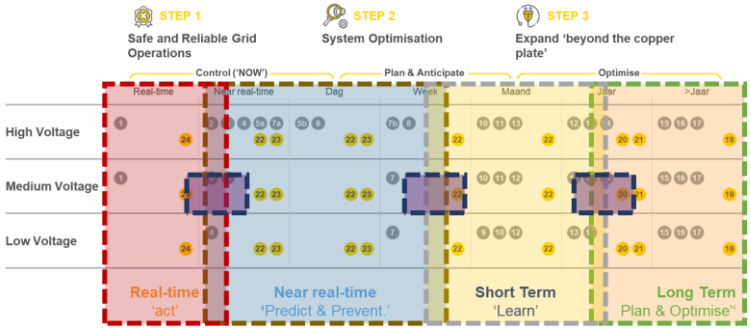


Getting forecasts and toolbox requires standards and solutions that work across the electricity value chain (and beyond). We are making our first steps







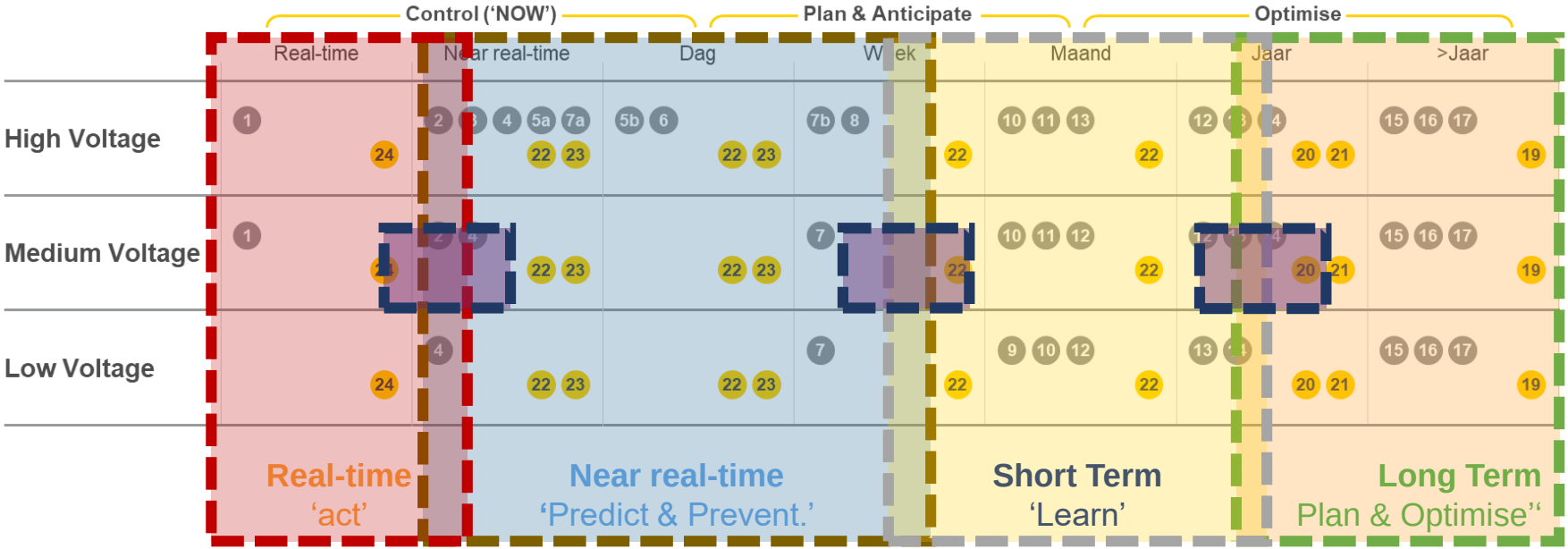


Architecture that supports the DSO with visibility in multiple time domains.

STEP 1
Safe and Reliable Grid Operations

STEP 2
System Optimisation

STEP 3
Expand 'beyond the copper plate'



Visibility across multiple time domains: examples

Network Planning

A digital grid model (SETIAM), calculation cluster (VISION/PowerFactory) and multi-year capacity scenario's allowing more accurate designs.

Transport forecasting

Predict grid usage. Intraday, day ahead up until 2 weeks ahead using consumption, own sensoring and DER forecast

Digital Twin

A digital asset model including a set of sensor feeds for better condition assessments. This helps maintenance planning and grid operations.

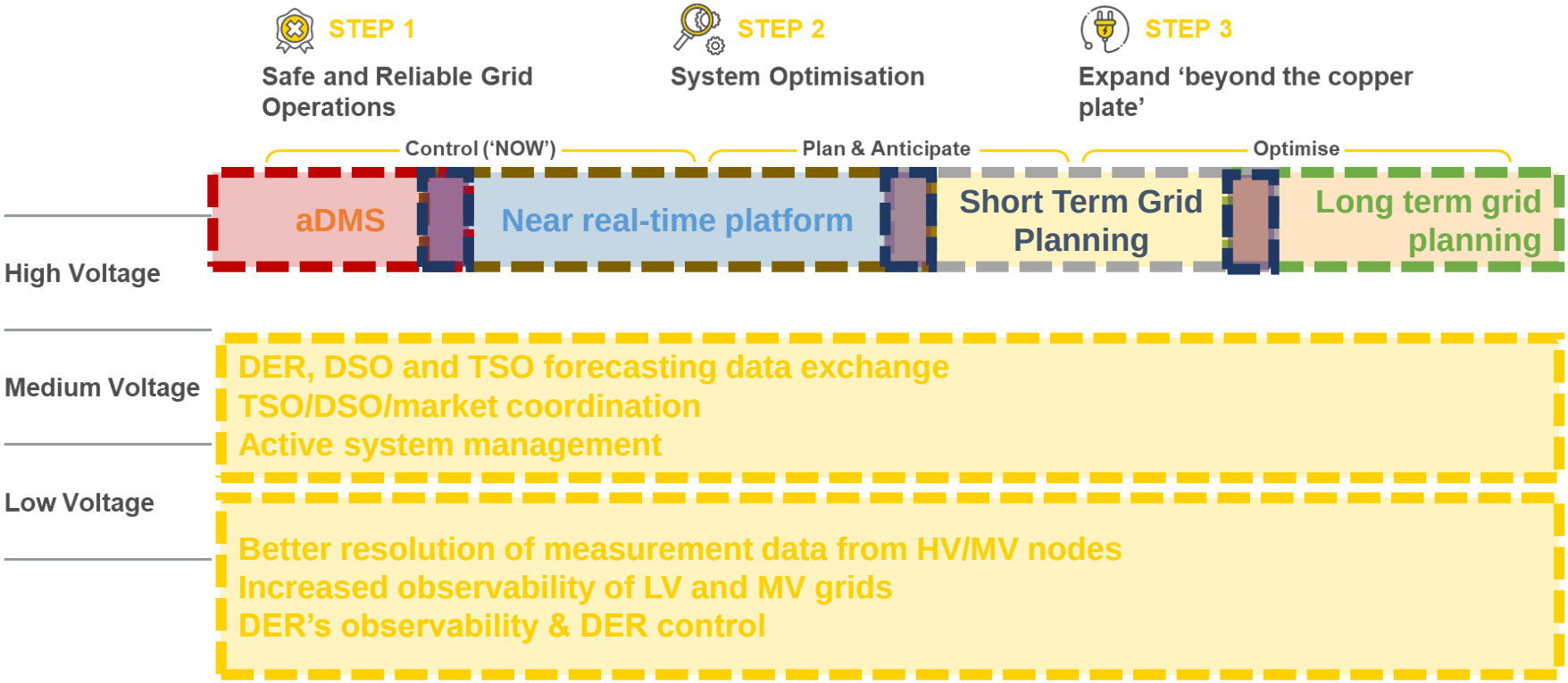
Real-time

Near real-time/intraday

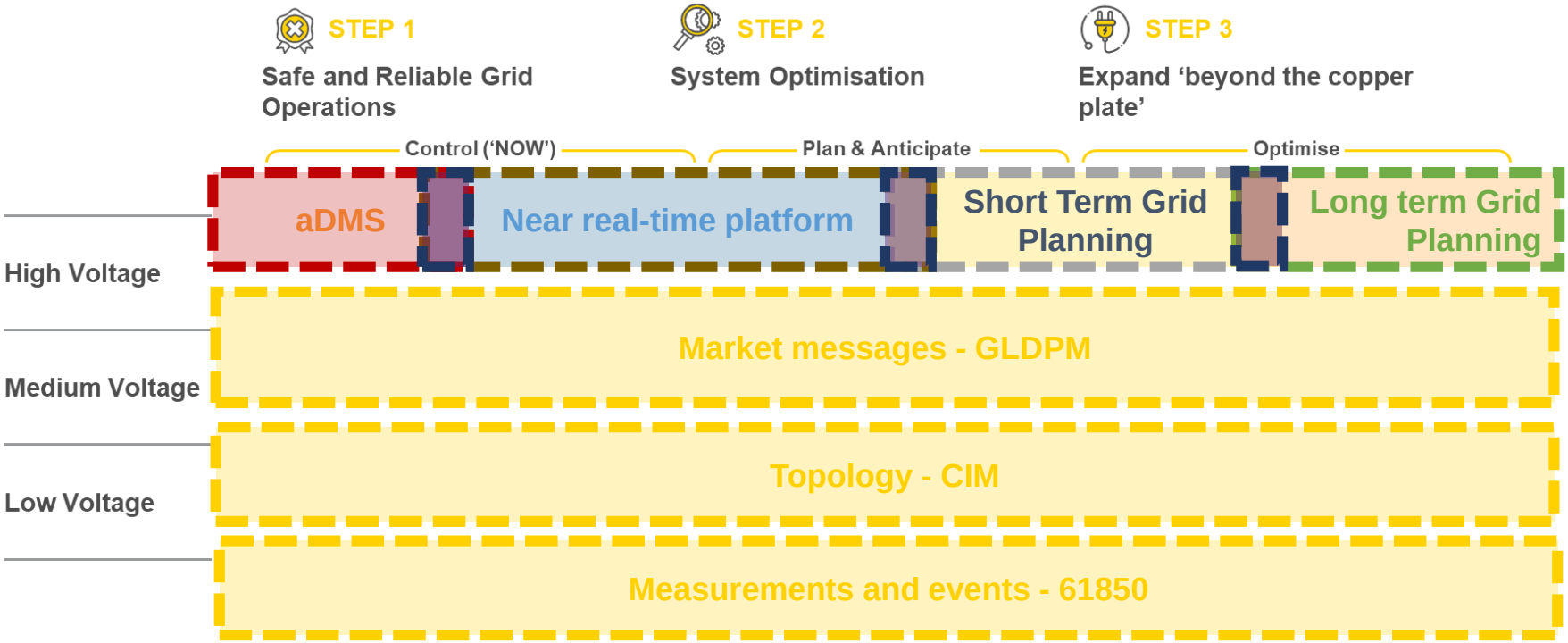
Short Term (Week-Month)

Long Term (Month - years)

Required data flows



Building an IT/OT architecture that supports de DSO across all time domains



Summary

Challenges

- Silo-ed processes and asset data
- Need to get visibility into the electricity system in order to optimize it.
- Need to plan for more sensoring, existing sensor feeds underused.

Solution

- One source of the truth, data modeling, data analytics capability
- Innovation lab for continuous development
- Use case development and target architecture.

Benefits

- Improved decision making
- Improved technology adoption rate
- Improved TSO/DSO coordination in grid design and day to day operations.

Questions?

Please wait for the **microphone**

State your **name & company**

Please remember to…

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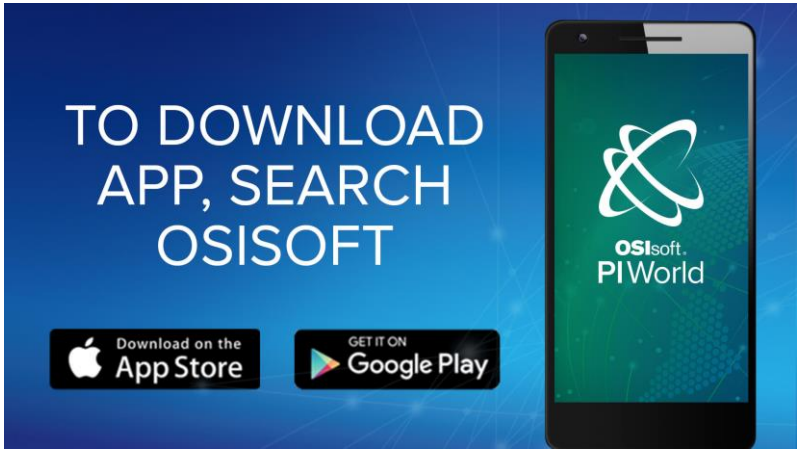

Speaker

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