

Tor B. Heiberg
CEO, Elhub AS

*Before, during and after
Elhub Go-live*

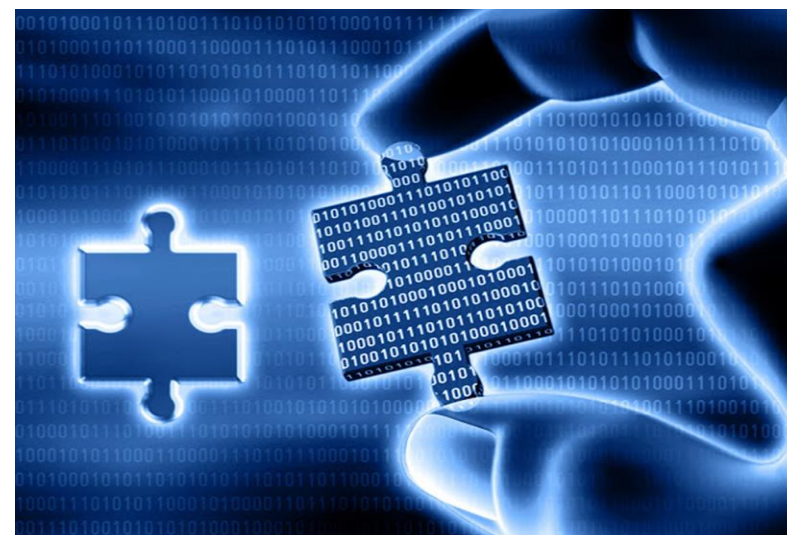
Ediel- och Avräkningskonferensen
October 9th, 2019
Arlanda

AGENDA

- About Elhub
- Preparations
- Go-live process
- After Go-live



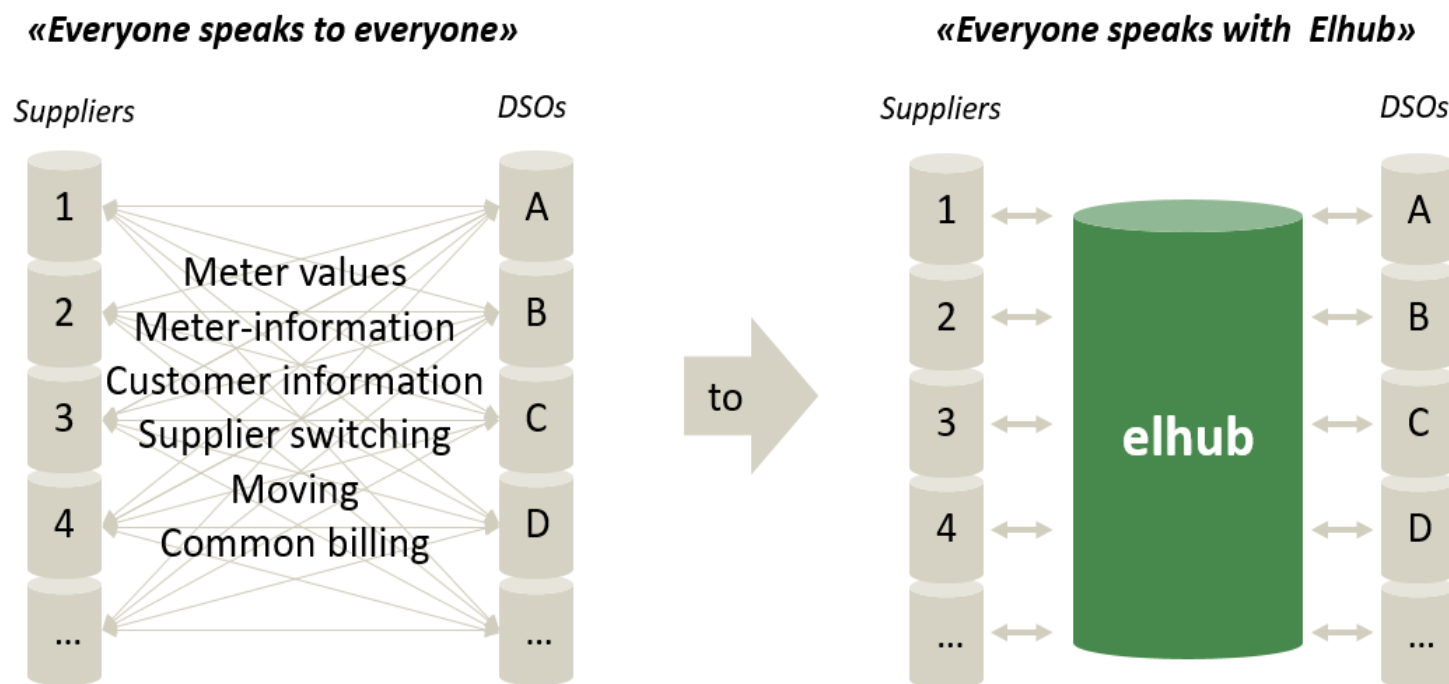
About Elhub



Facts

- ❑ Elhub is the datahub for the Norwegian electricity market
- ❑ Elhub AS is a 100% owned subsidiary of Statnett SF
- ❑ Elhub is governed by a licence from the Norwegian regulator (NVE)
- ❑ Elhub is mandatory for all market parties in the Norwegian electricity market with one or more of the following roles:
 - Grid company
 - Retailer
 - Balance responsible party
- ❑ Elhub went live February 18th, 2019
- ❑ Elhub has 379 members (customers)
 - 155 grid companies
 - 198 retailers (incl. suppliers of last resort)
 - 26 third parties for data access (energy service providers)
- ❑ 314 metering grid areas
- ❑ Approximately 3.25 million metering points in Elhub
 - 3.1 million smart metering
 - 0,15 million other

The concept of datahub



- One neutral interface between monopoly (DSO's) and the market (Suppliers)
- Centralized business processes and data storage
- Quality of the DSO can be monitored and benchmarked, e.g. for meter data

EMIF (Market Parties)	NOA - SN	NBS - eSett	NECS - SN	IFS - SN	NordPool	Altinn	Ediel
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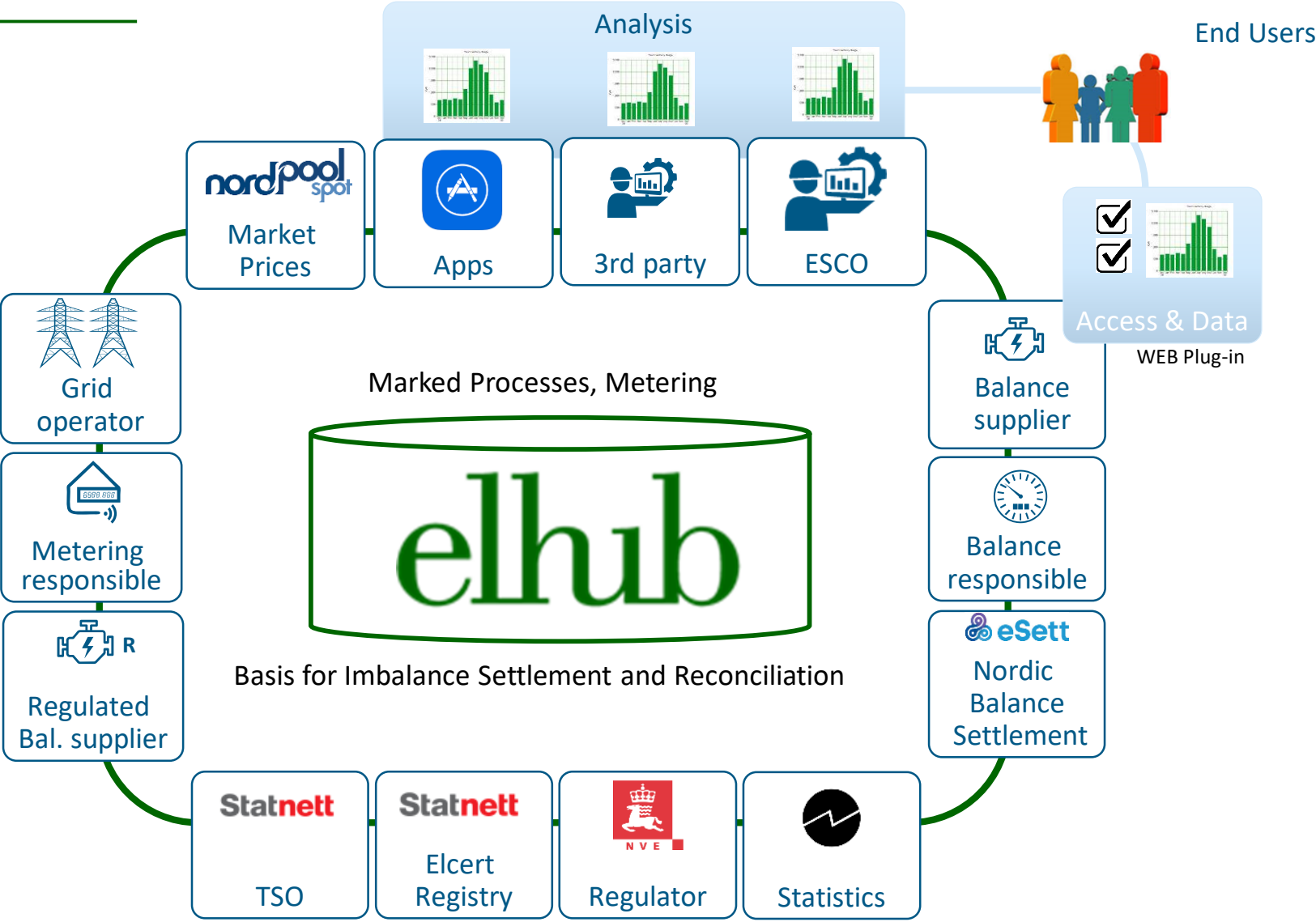
Structure Data Services	Market Processes Services	Metering Values Services	Calc. and Aggregation Services
Manage Market Parties	Change of Supplier and End User Moving	Receiving Interval Volumes	Imbalance Settlement Basis
Manage Grid Model	Change of MP and End User Information	Receiving Period Volumes	Final Grid Loss
Manage Balance Responsibility Contract	Distribution of Master Data	Distributing Metering Values	Reconciliation (ATAM/APAM)
	Change of Third Party Access	Follow Up Missing Metering Values	Preliminary Profiled Consumption PPC / TPC / FPC
	Request for Master Data and Services	Reminders for Metering Values	Estimation of Period Volume (EPV)
	Manual Master data update	Request for Metering Values	Quota Obligated Consumption (QOC)
	Manage Groups & Virtual MPs (VMP)	Update Estimated Annual Consumption	Production to NECS
	End User Access (web plugin)		Virtual Metering Point calculation
	Explore Metering Points (portal)	Explore Metering Values (portal)	Request for Settlement Results

Access management – EMIF, EQIF, Portal and Plug-in	Business Configuration and Access Management (Role/data)
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Statistics and reporting – Custom and OBIEE/BI	Insight and Analysis
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Subscription Fee Management (to IFS)	Invoicing
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Market Parties and Users

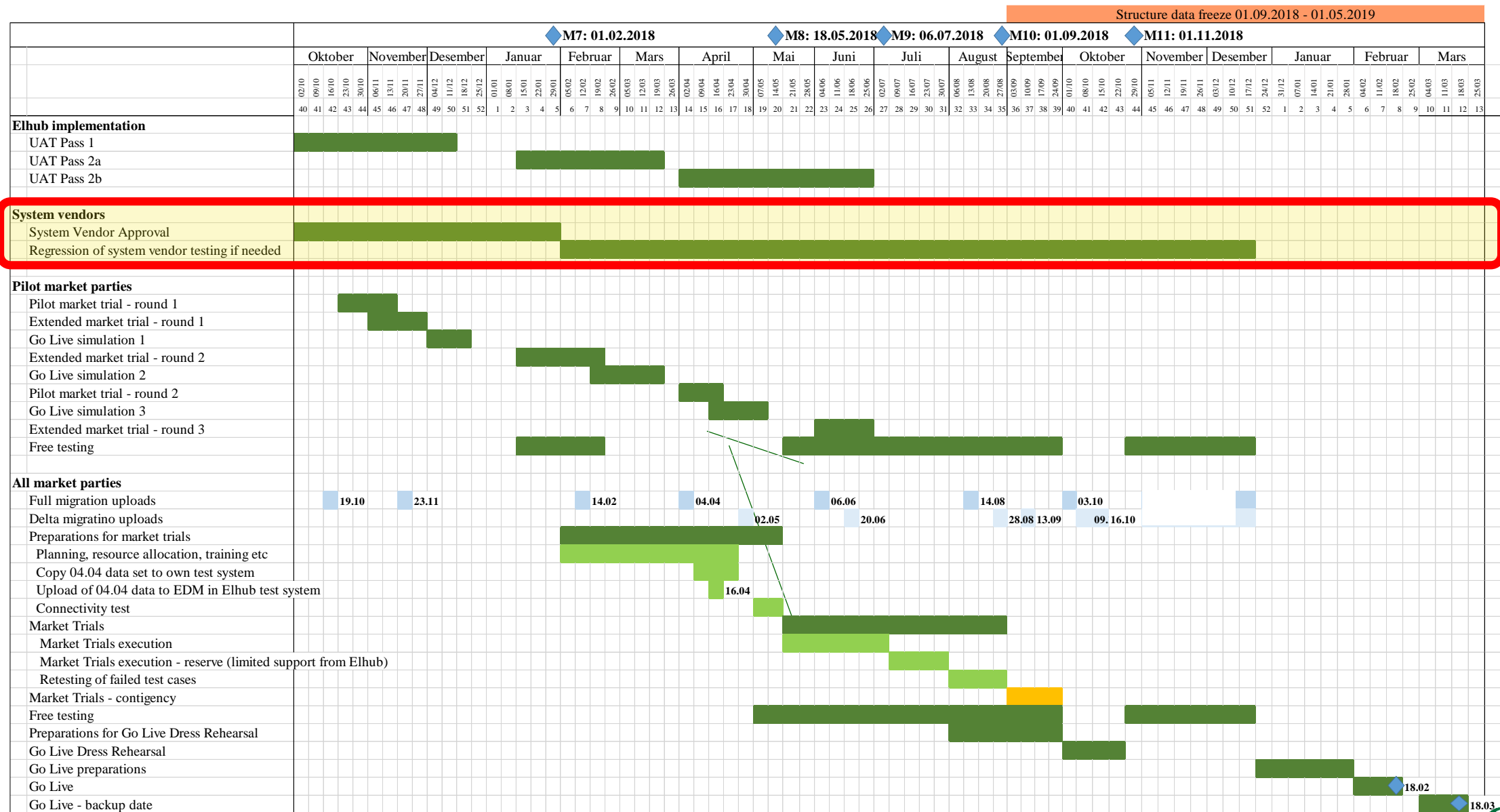
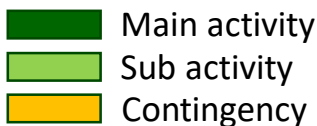


Preparations

Before, during and after Elhub Go-live



Plans Are Worthless, But Planning Is Everything
Dwight Eisenhower



System Vendor Trial (SVT)

- 80-90 testcases to be passed towards Elhub
- Focus on "Big 10" system vendors covering main part of the market

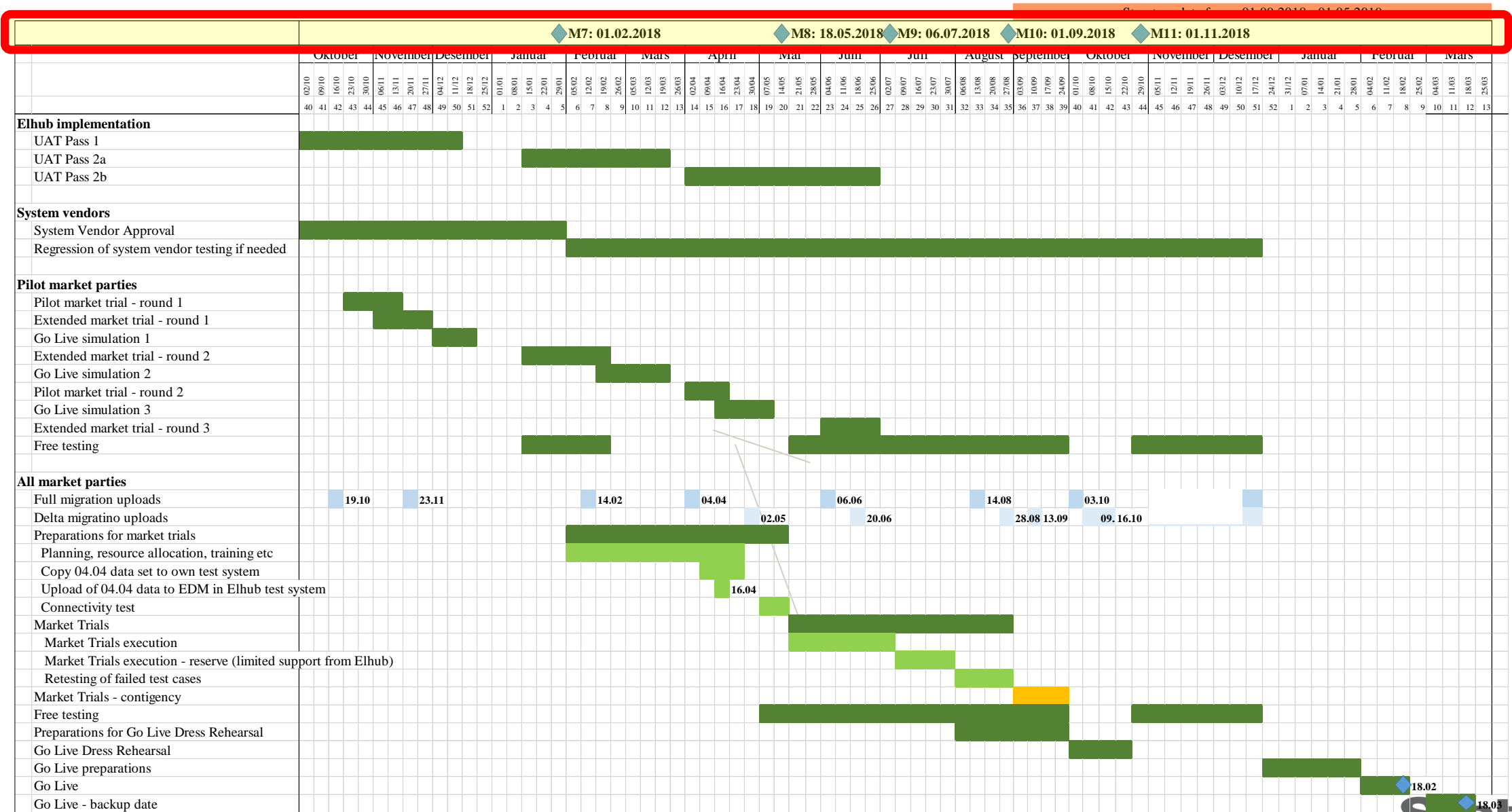
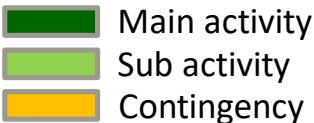
- Environment updated weekly with latest code
- Test environment available for system vendors untill Go-live
- Elhub provided support

Example of status during SVT:

10 Largest vendors (Big 10)		
Total Test cases	289	
Pass	277	95,8 %
Fail	0	0,0 %
Partial/Wait	12	4,2 %
Not tested	0	0,0 %

Aggregated All vendors		
Total Test cases	863	
Pass	308	35,7 %
Fail	1	0,1 %
Partial/Wait	24	2,8 %
Not tested	530	61,4 %

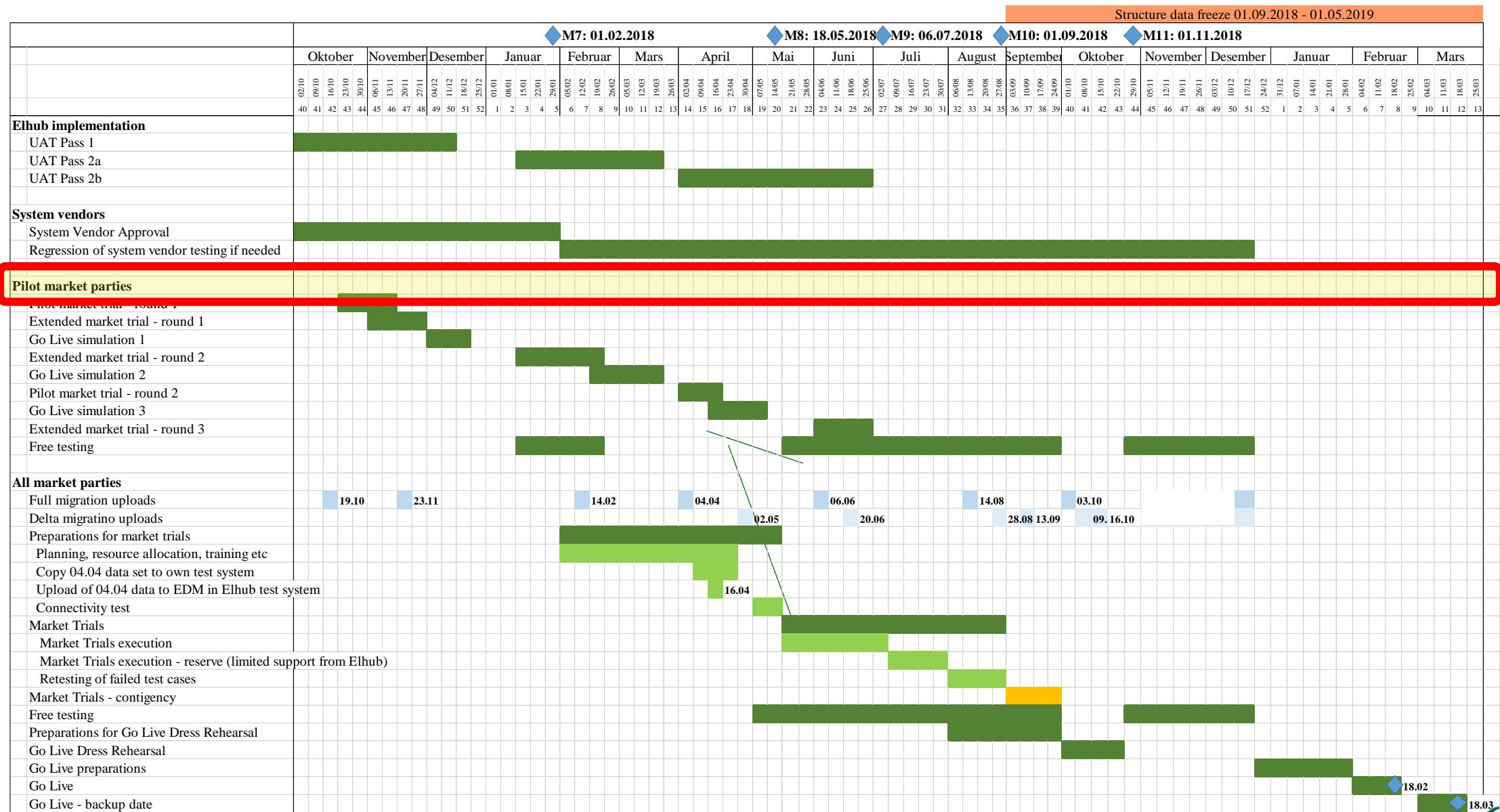
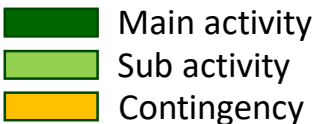
Key activities plan for market parties

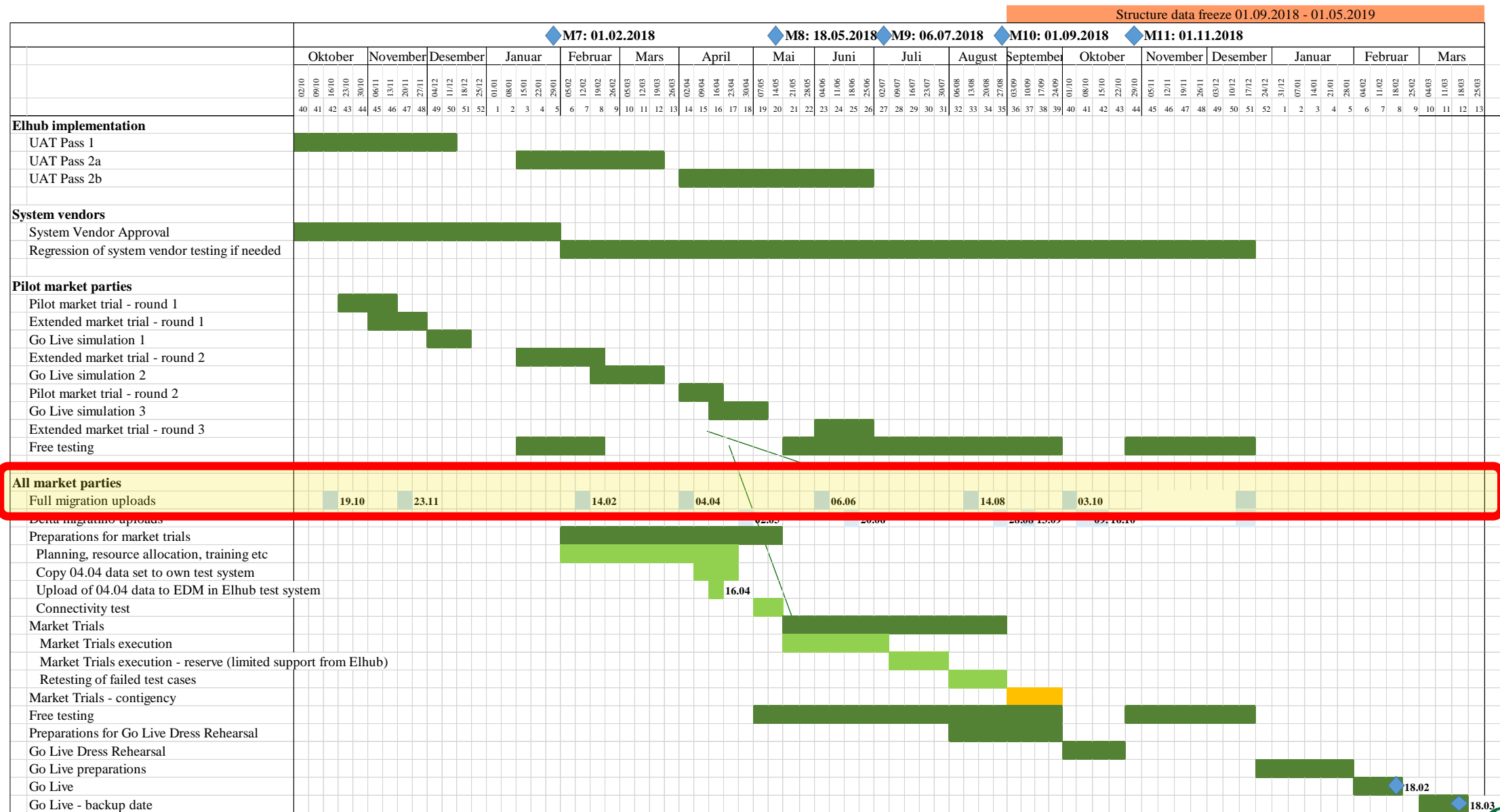
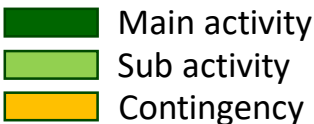


Milestones and criterias for market parties

Mile-stone	Acceptance Criteria			Date
	Activities completed	Data quality criticality 1	Data quality criticality 2	
M7	<ul style="list-style-type: none"> IT system approved at Elhub 	99.9 %	98 %	01.02.2018
M8	<ul style="list-style-type: none"> Ready for approval test towards Elhub Company details upated in Elhub portal Planning, resource allocation and training completed Test data loaded in own system and to Elhub migration tool Connection to Elhub test system verified Initial test BRS test for DSO completed 	99.9 %	98 %	18.05.2018
M9	<ul style="list-style-type: none"> Completede all test cases for the market party approval test 80% of all market party approval tests approved 	99.9 %	98 %	06.07.2018
M10	<ul style="list-style-type: none"> 100% of all market party approval tests approved Ready for Go-live Dress rehearsal 	99.98 %	99 %	01.09.2018
M11	<ul style="list-style-type: none"> Go-live Dress rehearsal completed Service agreement with Elhub signed DSO has reported completed set of meter data for all MGA's for at least 1 operational day within defined deviation from eSett imbalance reporting (1 % for production and exchange, 10% for consumption) Plan and resource allocation presented for all activities in in the Elhub Go-live process 	99.98 %	99 %	01.12.2018

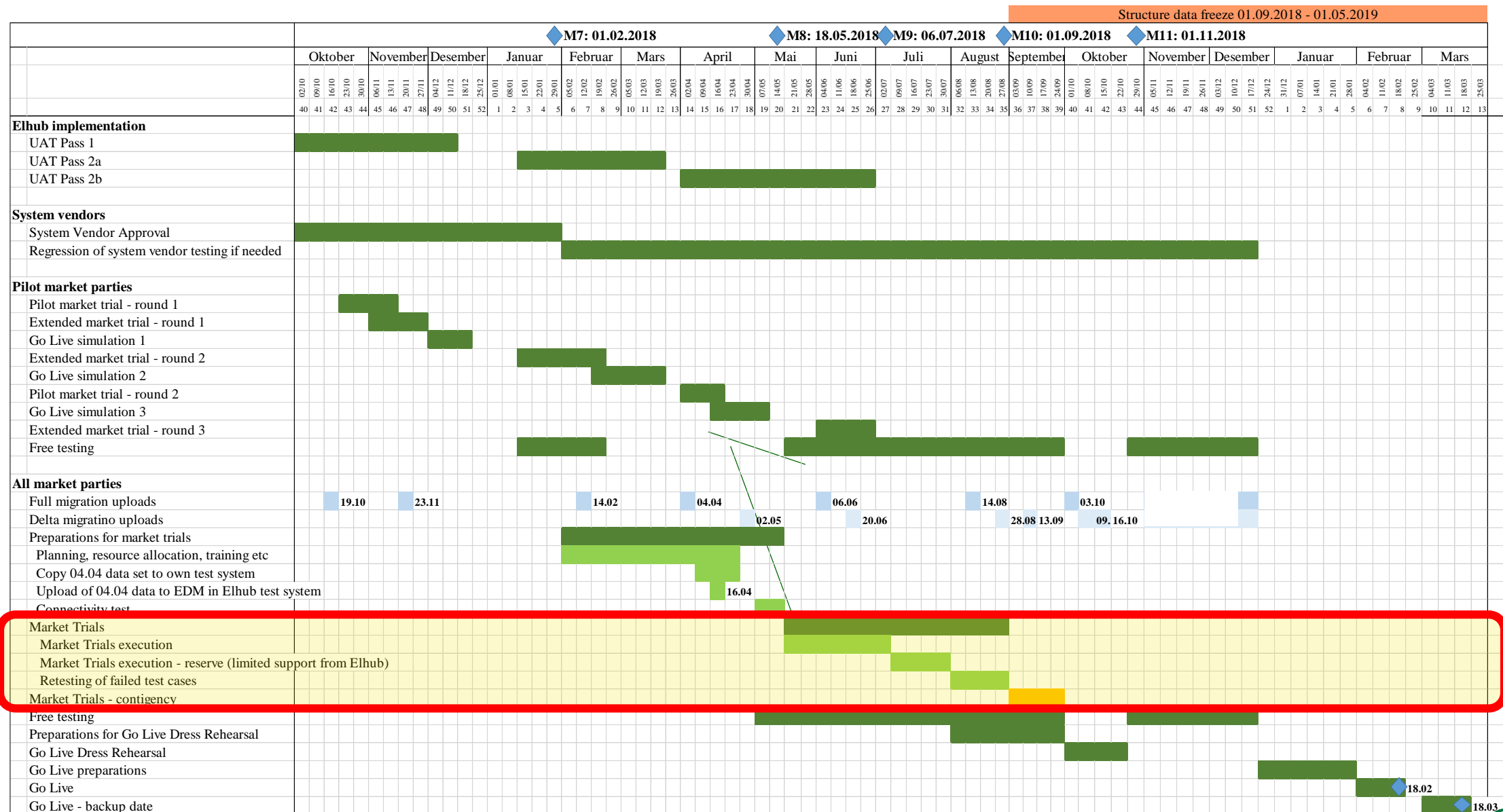
- Approved by regulator
- Mandatory for all market parties
- Two milestones could be sanctioned by regulator (financial penalty)





Key activities plan for market parties

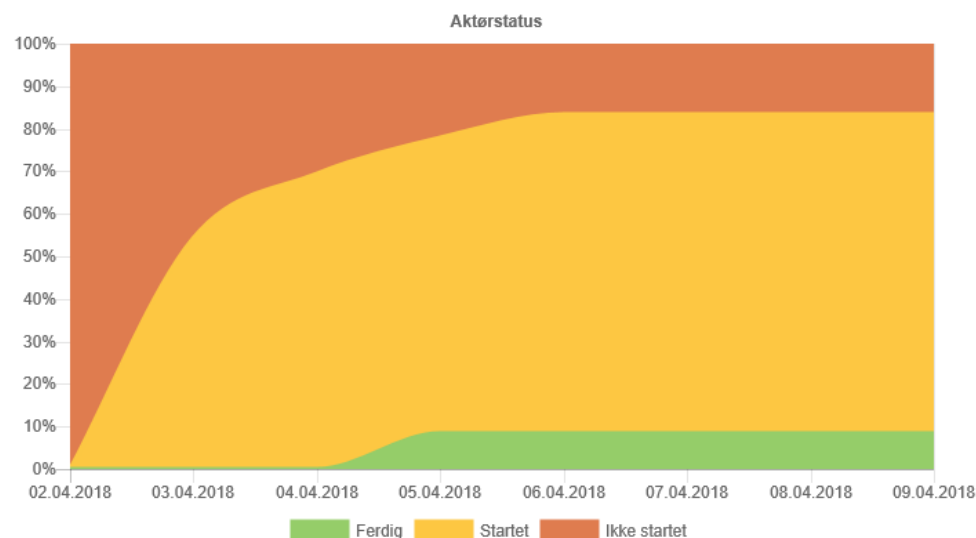
- Main activity
- Sub activity
- Contingency



Market participants test & approval

Approval of pilot market parties	ti 03.04.18	fr 20.04.18	Pilots
Golive simulation 3 (only masterdata upload)	ma 30.04.18	fr 11.05.18	Market Parties
Approval of market parties - preparations (connectivity test)	ma 30.04.18	fr 18.05.18	Market Parties
Approval of market parties	ma 21.05.18	fr 31.08.18	Market Parties
Approval of market parties - contingency	ma 03.09.18	fr 28.09.18	Market Parties

- Pilot Market trial round 2 was started as planned 3rd April and the Web-portal was made available from 9th April
- There were 25 pilots (36 different roles) covering all the different roles in Elhub and most of the IT system combinations in the market



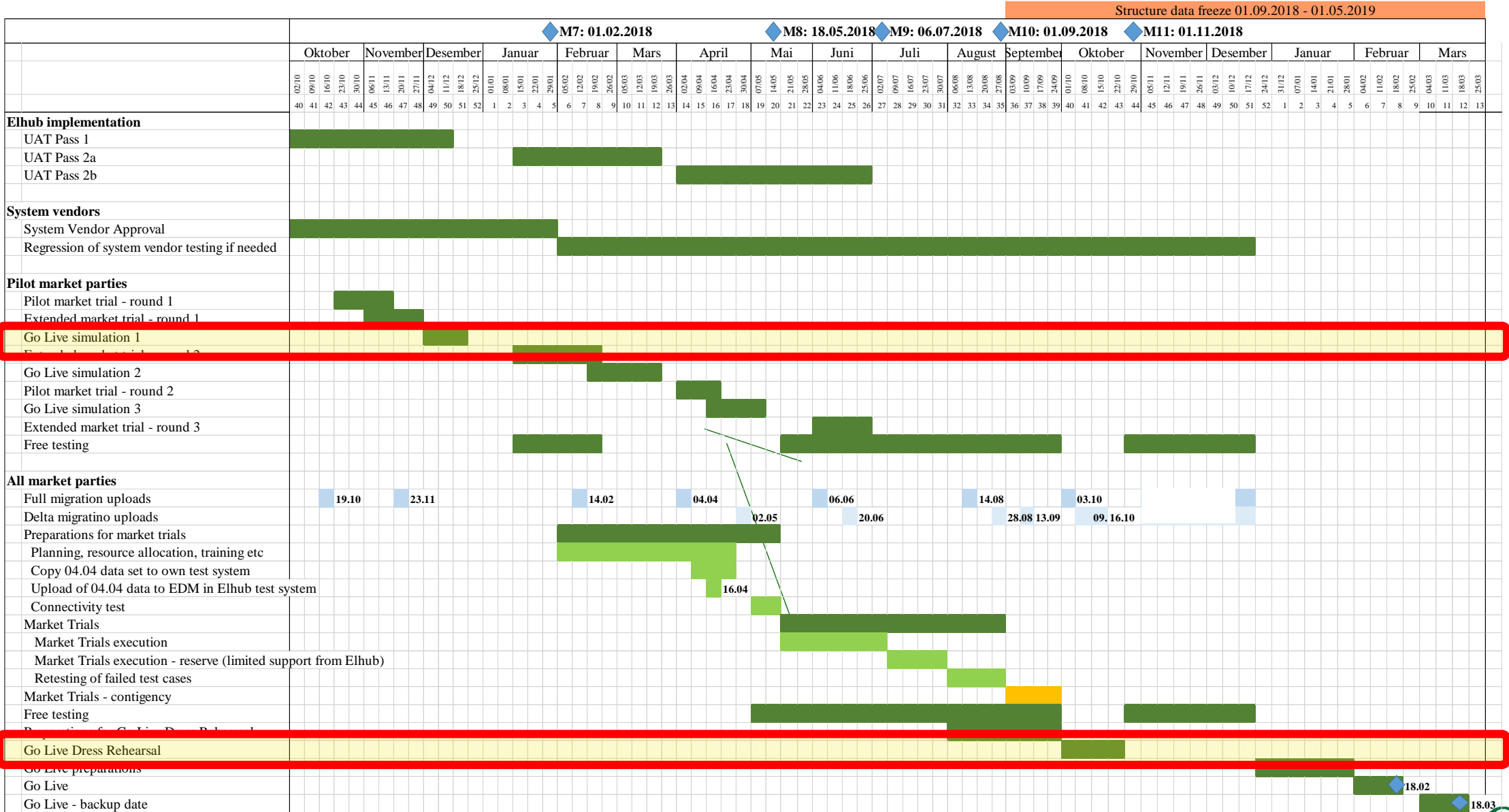
https://www.ediel.no/Portal/Milestone/Report/ELHUB_MX_RUN2

Aktør	Status	Aktør	Status
Hafslund Nett AS Pliktleverandør	Ferdig	Nordmøre Energiverk AS Nett Regulert	17%
HAFSLUND STROM AS	Ferdig	Vest-Telemark Kraftlag AS Nett	17%
HALLINGKRAFT AS	Ferdig	Akershus Energi Vannkraft AS	12%
LOS AS	95%	Embriq	12%
Ustekveikja Energi AS	89%	Nordmøre Energiverk AS	12%
Agder Energi Nett AS - Regulert kraftleverandør	84%	Neset Kraft AS Nett	10%
Hafslund Nett AS	84%	Statnett SF	6%
SFE Nett REG Kraftleverandør	84%	Høland og Setskog Elverk Nett	4%
Hydro Aluminium AS (Nett)	81%	Nordmøre Energiverk AS Nett	4%
Agder Energi Nett AS	64%	Eidsiva Nett AS - Regulert kraftlev	0%
Eidsiva Marked AS	62%	Kvinnherad Energi AS - Nett	0%
Skagerak Nett AS	60%	Neset Kraft AS	0%
SFE Nett AS	57%	Gurusoft AS	Ikke startet
Skagerak Nett AS Regulert	50%	Høland og Setskog Elverk	Ikke startet
NorgesEnergi AS	39%	Neset Kraft AS Regulert kraftleverandør	Ikke startet
Hafslund Nett AS Innsamler	34%	SMARTHUB AS	Ikke startet
Trønderenergi Nett AS	30%	Statnett Nettap	Ikke startet
Eidsiva Nett AS	24%	Validér AS	Ikke startet

- Market trial for all market parties (~350) started 21st May and lasted until 31st August
- Preparations included migration of testdata to Elhub and upload of the same data into market parties test systems

Key activities plan for market parties

- Main activity
- Sub activity
- Contingency



Go-live process

Before, during and after Elhub Go-live



Big Bang

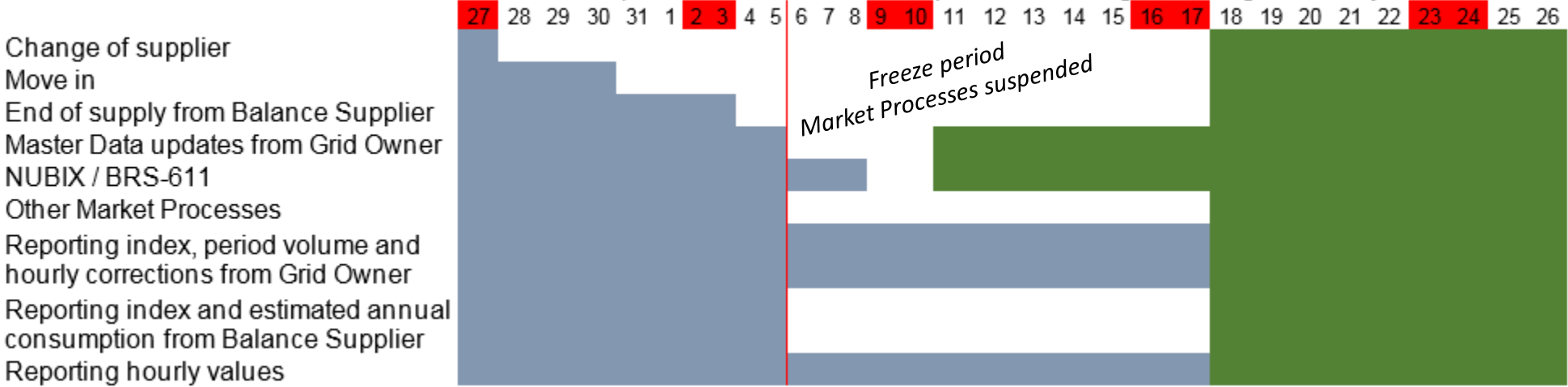
BACKGROUND FOR THE GO LIVE PROCESS

- Go Live was a complicated process for Elhub, the market actors and system vendors
- It was a paradigm shift in several dimensions:
 - Change in business processes
 - Change in message formats and addresses
 - Change from distributed to central data model
- Due to this, we needed a controlled and well-choreographed process for Go Live
- There was a need for a freeze in the market to ensure that Elhub goes live with accurate migrated data
 - This meant that the market participants' data should be unchanged while Elhub migrated and assured the data quality
- The duration of the freeze period was different for the various processes
 - The duration was determined by the processing time of the various processes, but it was a "core freeze period" of 2 weeks.



GoLive - overall process and plan

Simplified illustration of freeze period in message exchange February 2018



	01/10	08/10	15/10	22/10	29/10	05/11	12/11	19/11	26/11	03/12	10/12	17/12	24/12	31/12	07/01	14/01	21/01	28/01	04/02	11/02	18/02	25/02	04/03	11/03	18/03	25/03	01/04	08/04	15/04	22/04
Activity	40	41	42	43	44	45	46	47	48	49	50	51	52	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Go Live Dress Rehearsal																														
Go Live preparations (Entry criteria, migration, connectivity, configuration)																														
Entry criteria (deployment, technical users, incident management)																														
Prepare environment (wipe, connectivity, configuration)																														
Initial data migration (upload, staging, loading, QA)																														
Market Party Connectivity and QA of data																														
Parallel reporting of metering values from Grid Companies																														
Delta data migration (upload, staging, loading, QA)																														
QA of data and bufring of market processes																														
Go Live																														
Delta data migration (upload, staging, loading, QA) and Freeze Week																														
Startup week (only BRSs for metering values and master data)																														
First week of production (special rules for some BRSs)																														
Second week of production																														
Go Live - back up date																														

FREEZE PERIOD – STRUCTURE DATA CHANGES

To ensure stability in the Go Live period, Elhub introduces freeze on structure data changes in the period 01.09.2018 – 01.05.2019.

- No mergers (transfer of Balance Supplier responsibilities/Balance Responsible/Metering Reporting Responsibility for large amounts of metering points)
- No new establishments (new balance suppliers, new grid owners, new third party actors)
- No new grid areas, no removal of grid areas, no adjustments of limits between grid areas
- No change to system setup/system vendor
- Portfolio acquisition by bankruptcy and loss of license is permitted

The following structural changes are not allowed during the period 02.01.2019 - 01.05.2019

- Change of balance responsibility

OVERVIEW – GO LIVE PROCESS

Go/No Go: Go Live process start up at the turn of the year



- Elhub approved in UAT and put into operation
- The market actors' data quality according to claim. Level 1: 99.98%, Level 2: 99%
- The actors' IT systems approved against Elhub
- Go Live rehearsal completed
- Daily measurement reporting verified by all actors

Preparations ~5 weeks

Reset of environment. Migration and verification of sharp data for production (checklists). Configuration of parameters for grid loss. Subnet setup. Connectivity test. Login web portal. Gradual freeze of market processes.



Go/No Go: Start of market freeze – Market actors begins to hold back all market processes and caches messages.

Week 6

Freeze week: Final migration to Elhub. Quality assurance of data in Elhub while actors report any outstanding deviations.



Go/No Go: Market actors initiates system upgrades – Point of no return.

Week 7

Start-up week: Upgrading/activating Elhub functionality among the actors. Grid owners submit master data updates. Metering values are settled by grid owners and distributed via Edifact and parallel to Elhub. Manual corrections in Elhub.

Week 8

First operating week: Grid owners submits metering values. Metering values are settled in Elhub. Balance suppliers start submitting buffered market processes.



Elhub Go Live date (Monday week 8)

←→
FREEZE OF
METERING POINT
DATA
←→
FREEZE OF CONTRACT DATA

COLLABORATION DURING ELHUB GO LIVE



- Detailed description of all activities in the "Commissioning Run Book" for the dress rehearsal - updated throughout the process
- All markets actors reports their own activities in the Edielportal. Selected status updates is published on elhub.no
- Daily Skype meetings open to all actors at. 09:30.
- Service announcements are posted continuously on elhub.no.
- Information regarding decisions about Go/No Go checkpoints is also communicated via SMS to the actors' Elhub managers.
- Inquiries to post@elhub.no and phone 23 90 30 40.
- Overall plan (this document) and overall day-by-day spreadsheet are support documents and is not updated during the process

COMMISSIONING RUN BOOK - OVERALL PLAN FOR THE GO LIVE PROCESS DAY BY DAY

Go Live - Go Live

Sikker | https://dok.elhub.no/golive

elhub

Go Live

> CRB

> Sjekkliste

Go Live

Sist oppdatert 2018-01-23 10:11

• CRB

• Leseguide for markedsaktørene

• 01 - Prepare Environment

• 02 - Initial Migration and Structure Data Establishment

• 03 - Market Party Connectivity and verification of metering value reporting

• 04 - Final migration

• 05 - Freeze of market processes and start up week

• 06 - Start of Production

• 07 - Aftermath

• Sjekkliste

• Sjekkliste for nettselskaper

• Sjekkliste for tjenesteleverandører

• Sjekkliste for kraftleverandør (inkl. re

• Sjekkliste for balanseansvarlig

• Sjekkliste for tredjepart

			avvik		avvik			
2.8.6	Sjekkliste for balanseansvarlige	26/10	26/10 16:00 for rapportering av avvik 14/11 for utbedring av avvik	8/2	8/2 16:00 for rapportering av avvik 14/2 for utbedring av avvik	Balanseansvarlige (DDK)	Sjekkliste som brukes internt av balanseansvarlige for å kvalitetssikre data gjennom Elhub Web Portal og BRSer etter endt initiell migrering og frem til Go Live. Sjekkliste for balanseansvarlig	NA
2.8.7	Sjekkliste for tredjepart	26/10	26/10 16:00 for rapportering av avvik 14/11 for utbedring av avvik	8/2	8/2 16:00 for rapportering av avvik 14/2 for utbedring av avvik	Tredjeparter (AG)	Sjekkliste som brukes internt av tredjepart for å kvalitetssikre data gjennom Elhub Web Portal og BRSer etter endt initiell migrering og frem til Go Live. Sjekkliste for tredjepart	NA
2.8.10	Back up EnergyIP DB including HBASE	26/10	26/10	8/2	8/2	Accenture	We make a DB restore point after all corrections to the structure data are done. TA - ExArch - Infra - Exadata Energyip DB Backup	<input type="checkbox"/>
2.8.11	Sjekkpunkt Datakvalitet i Elhub ok, avvik er håndterbart -> start systemoppgradering (POINT OF NO RETURN)	29/10 9:00	N/A	9/2 8:00	N/A	Elhub	Alle aktører har gått gjennom oppstartssjekkliste og rapportert avvik Antall feilede målepunkter eller manglende målepunkter skal være under et håndterbart antall.	<input type="checkbox"/>



Successful completion of the Elhub Go Live Process!

- **07.02.2019:** Data migration completed
- **10.02.2019:** DSO Skagerak and DSO Hafslund sent the first master data updates
- **11.02.2019:** Remaining DSO's (137) sent buffered master data updates. Elhub opened for BRS-NO-611
- **18.02.2019:** Retailers sent buffered marked messages
- **19.02.2019:** First MGA imbalance calculation for 18th February (314 MGA's in Norway)
- **21.02.2019:** Last cut-over for meter data from DSO 18.02.2019
- **26.02.2019:** D+5 MGA calculation for 18.02.2019, first MGA reporting to market parties and eSett (the Nordic imbalance settlement company).

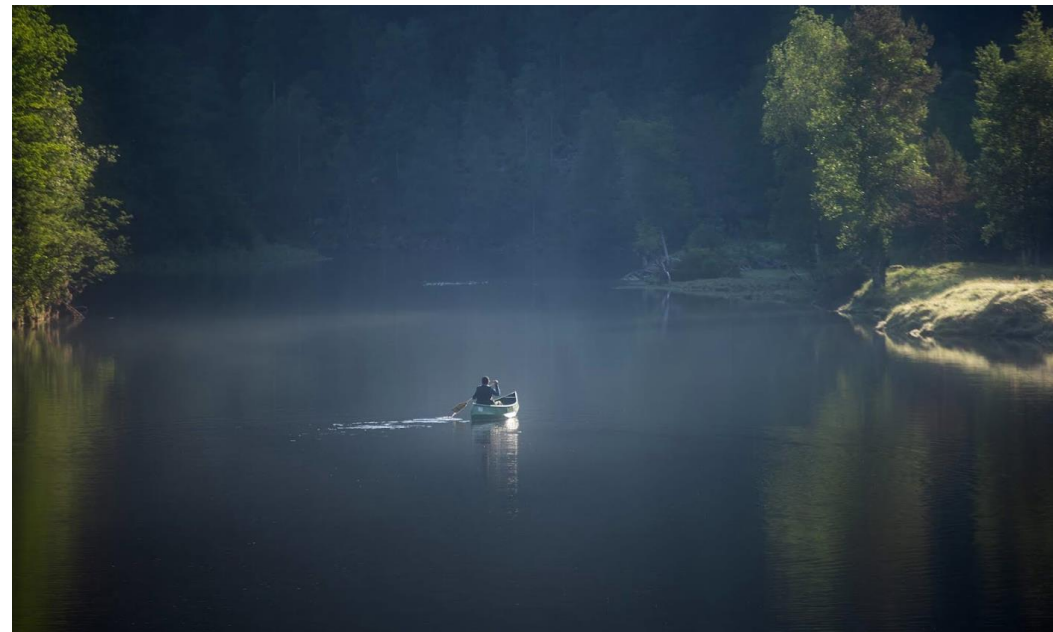
Sunday - Feb. 10th – 08:09 am:

Exiting moment when awaiting the first real production messages to be exchanged with Elhub



After Go-live

Before, during and after Elhub Go-live



Go-live de-brief

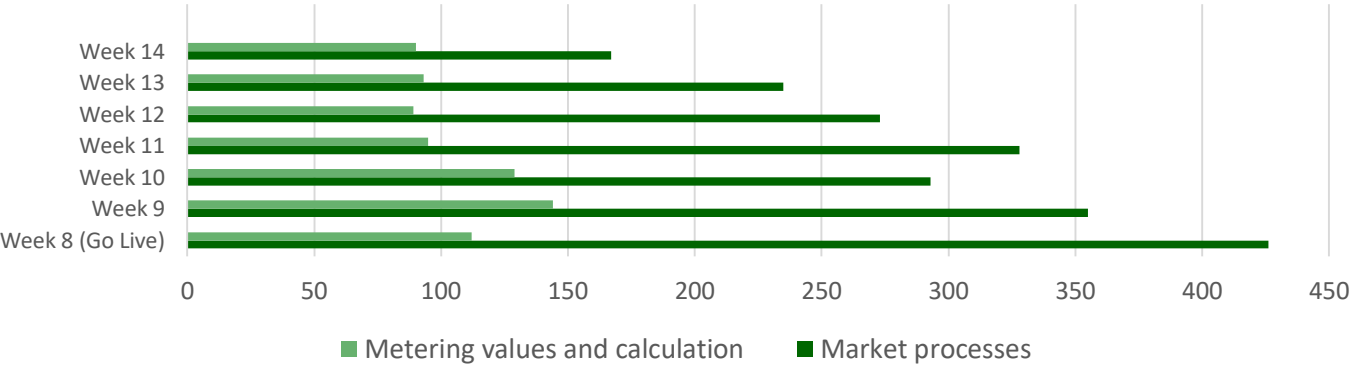
- Accomplished a complex and comprehensive start-up with success.
 - Large data-set migrated into Elhub, with a very strict regime for starting up – open up for the market.
 - Large volume of market processes handled correctly every day - 24/7/365
 - Metering values received daily and distributed to market parties - 24/7/365
 - Elhub calculate and distributes basis for settlement and most supplier are able to invoice their customer based of the values - 24/7/365

- There has been several challenges
 - Still large challenges at grid companies sending complete set of metering data with sufficient quality
 - Some functional defects at market parties system providers and in Elhub, both connected to market processes and meter value distribution
 - Many market parties was not well enough prepared for the operations after Elhub Go-live
 - Cyberattack at Norsk Hydro had large consequences (38 MGA's) in delivering metering values and ended up with delays
 - Change to summertime
 - Issues in interfaces and data between Elhub- eSett and Elhub - NECS

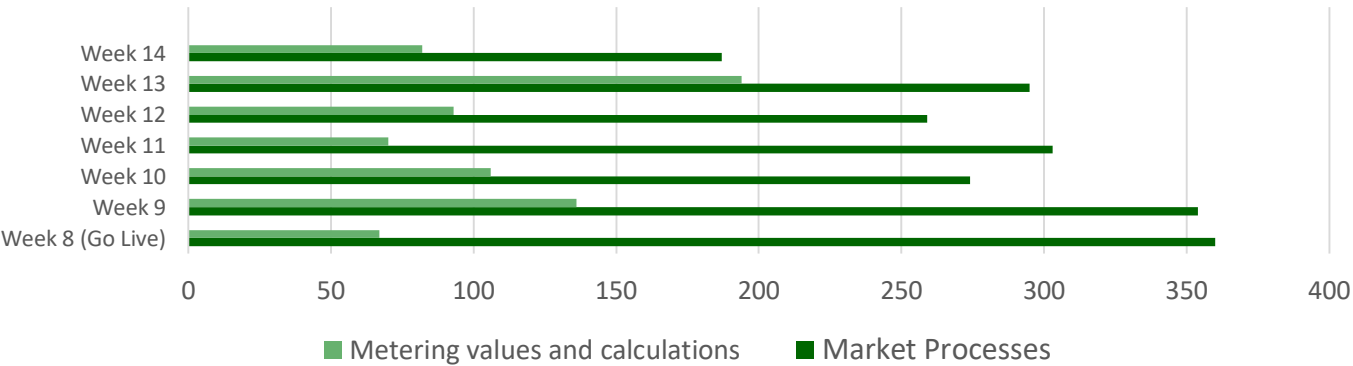


Operational support first 7 weeks

Incoming issues / requests

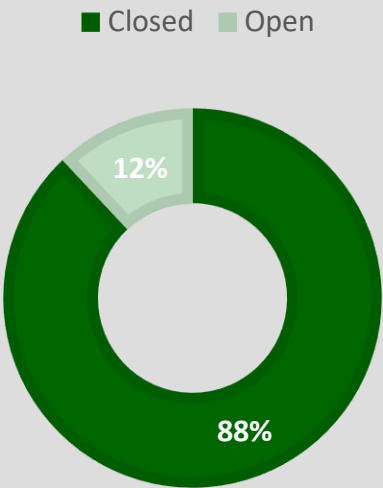


Closed



Incoming issues/requests
2882

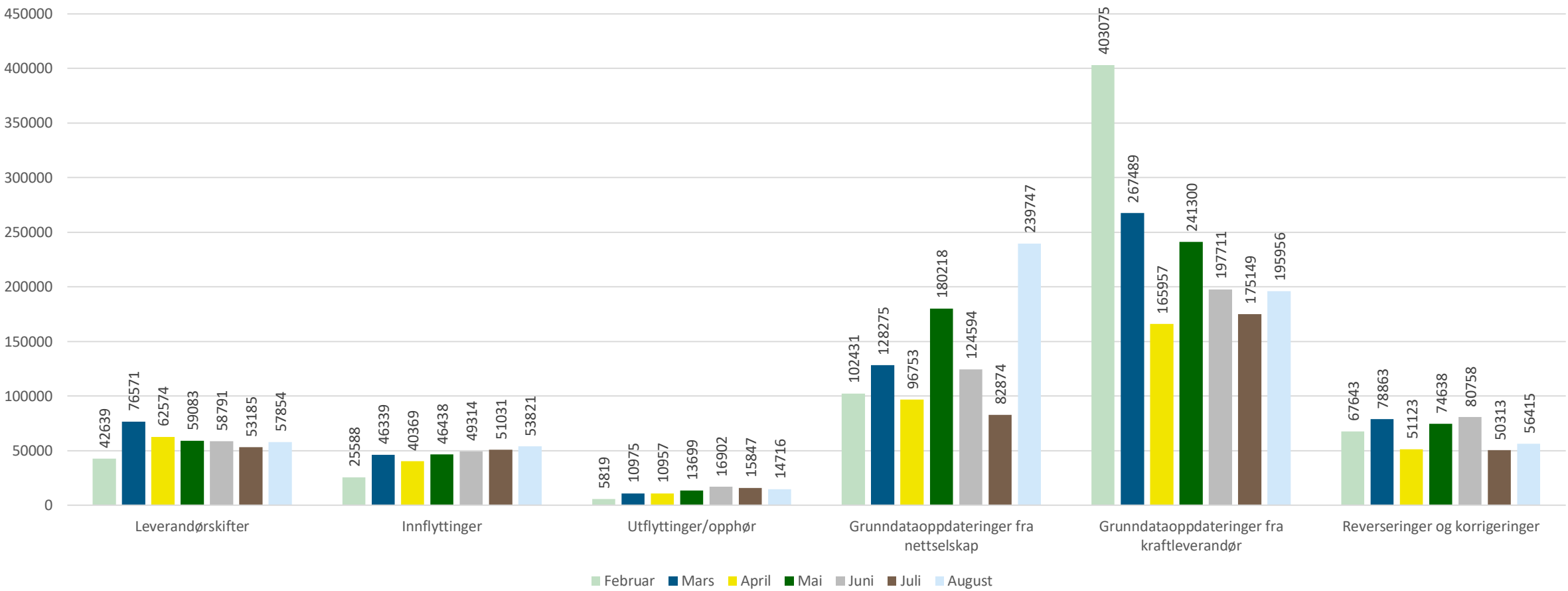
Closed issues
2555



Statistics week 14, 2019 – market processes

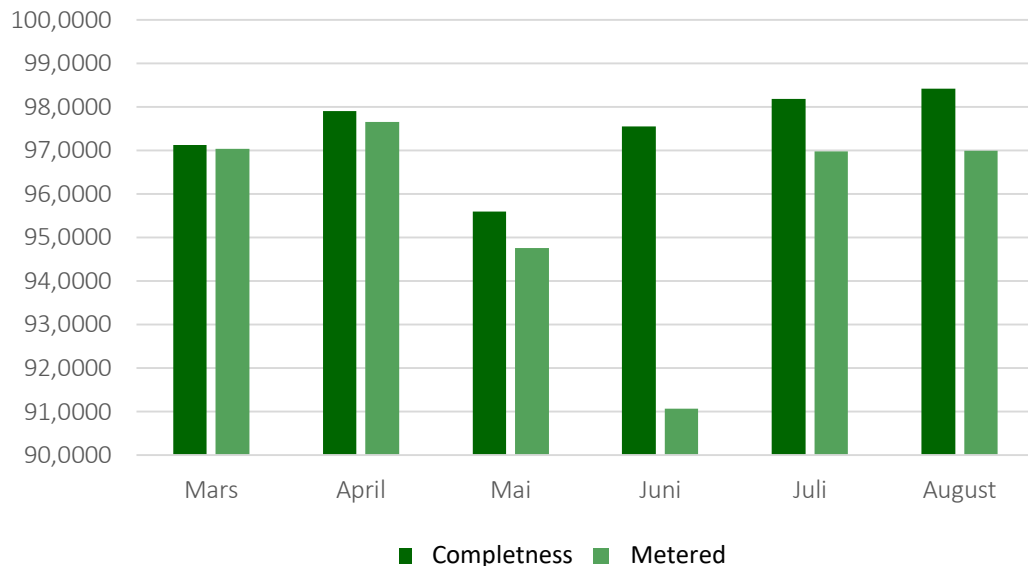
BRS		01.04.2019	02.04.2019	03.04.2019	04.04.2019	05.04.2019	06.04.2019	07.04.2019	Sum	
BRS-NO-101	Oppstart kraftleveranse - Leverandørskifte	3 860	2 914	2 193	3 784	3 344	1 049	786	17 930	Change of supplier
BRS-NO-102	Oppstart kraftleveranse - innflytting tilbake i tid	308	100	89	64	127	23	6	717	
BRS-NO-103	Oppstart kraftleveranse - innflytting frem i tid	2 124	2 054	1 658	1 638	2 024	106	14	9 618	
BRS-NO-104	Oppstart kraftleveranse - Leverandørskifte fra leveringsplikt	572	314	330	379	268	5	3	1 871	Move in/out
BRS-NO-111	Reversering av oppstart kraftleveranse	44	122	70	71	50	-	2	359	
BRS-NO-121	Nytt målepunkt	450	740	511	373	257	-	-	2 331	
BRS-NO-122	Aktivering av målepunkt	189	156	224	237	138	-	-	944	
BRS-NO-123	Oppstart i målepunkt - innflytting	956	816	843	827	541	32	22	4 037	
BRS-NO-132	Reversering av aktivering av målepunkt	1	5	5	4	2	-	2	19	
BRS-NO-133	Reversering av oppstart i målepunkt	9	21	17	16	10	-	-	73	
BRS-NO-201	Opphør pga utflytting	546	338	302	177	195	34	27	1 619	
BRS-NO-202	Opphør av kraftleveranse	171	586	91	117	63	1	30	1 059	
BRS-NO-211	Utflytting fra målepunkt meldt til netteier	118	114	107	104	116	79	2	640	
BRS-NO-212	Deaktivering av målepunkt	165	125	187	148	132	7	1	765	
BRS-NO-213	Fjerning av målepunkt	70	21	96	56	66	-	-	309	
BRS-NO-221	Reversering av opphør kraftleveranse	25	8	27	261	9	-	-	330	
BRS-NO-222	Reversering av utflytting fra målepunkt	13	6	5	6	5	-	-	35	
BRS-NO-223	Reversering av deaktivering av målepunkt	20	27	18	35	22	-	2	124	
BRS-NO-224	Reversering av fjerning av målepunkt	-	6 764	1	8 878	8 536	-	-	24 179	
BRS-NO-301	Oppdatering av grunndata - kraftleverandør	18 860	3 635	11 435	2 511	3 338	1 975	792	42 546	
BRS-NO-302	Oppdatering av grunndata - nettselskap	16 395	41	4 355	31	32	333	55	21 242	
BRS-NO-303	Spørring grunndata	43	117	44	220	211	-	-	635	
BRS-NO-306	Endring i avregningsform	4 388	1 132	202	600	743	-	-	7 065	
BRS-NO-311	Målerstand og antatt årsforbruk fra kraftleverandør	1 688	115 977	953	49 745	1 086	30	12	169 491	Est. annual cons.
BRS-NO-315	Spørring måleverdier	1 650	51 748	91 894	4 759	18 388	271	180	168 890	
BRS-NO-317	Oppdatering av antatt årsforbruk	7 002	11 082	59 157	2 126	12	137 493	31 138	248 010	
BRS-NO-402	Korrigerings av grunndata fra nettselskap	2 028	54	2 509	21	2 358	123	178	7 271	
BRS-NO-601	Forespørsel til nettselskapet	23	2	32	4	19	-	-	80	
BRS-NO-611	Verifisere grunndata i målepunktet (spørre etter mp id)	90 999	75 133	70 402	113 091	78 311	46 827	7 328	482 091	Requests
BRS-NO-622	Oppdatering av tredjeparts tilgang	46	5 915	210	119	74	-	-	6 364	
Totalt		145 405	273 823	243 116	184 093	120 477	187 205	39 769	1 193 888	Statnett

No. of market processes since start up

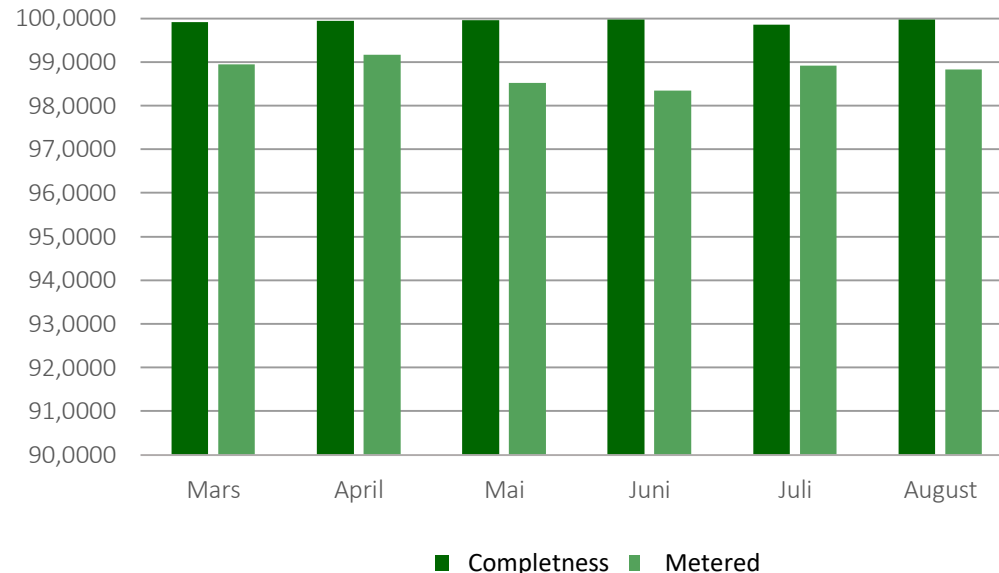


Meter data reporting; completeness and quality

Average % completeness and quality at 7am the day after (D+1):



Average % completeness and quality at the 5th day after (D+5):

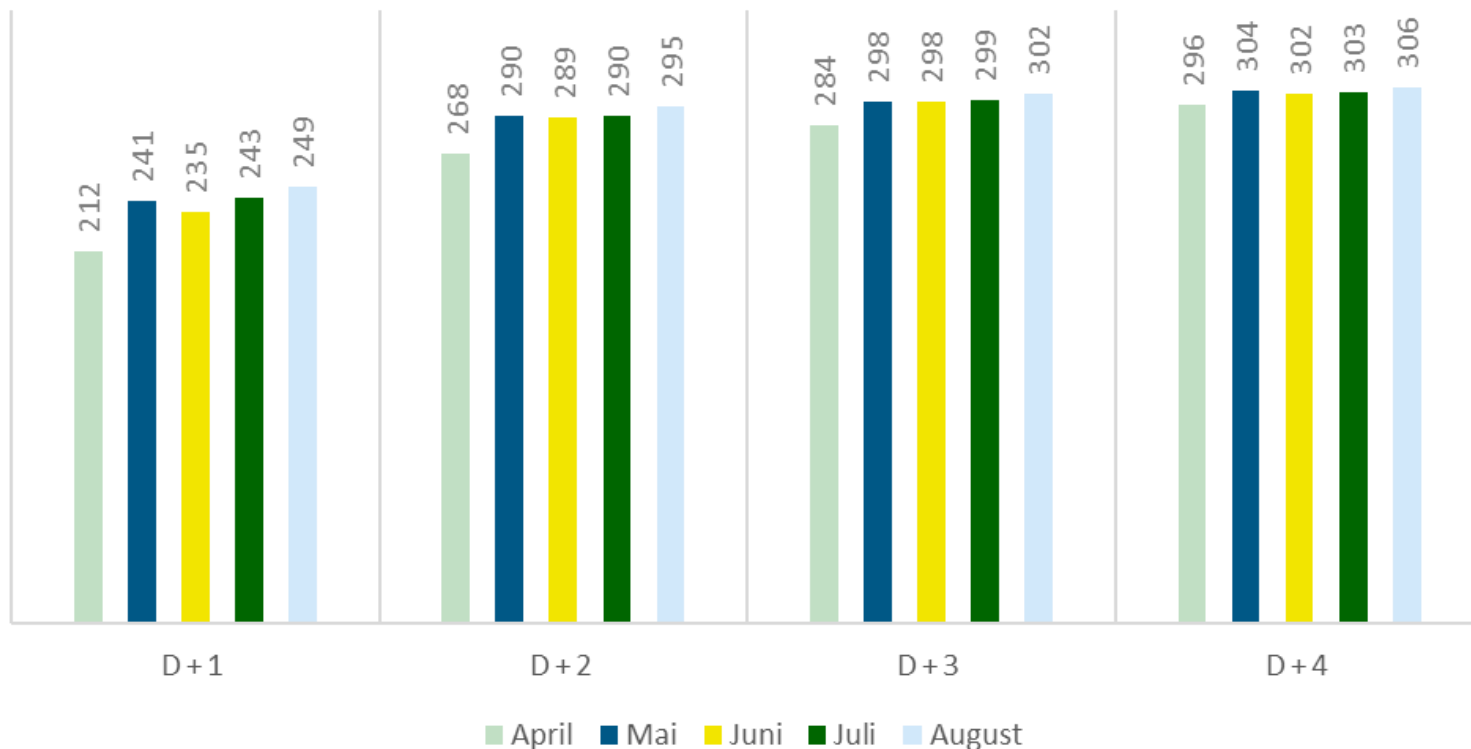


- DSO shall according to the regulation report metered data for the previous day before 7am for all metering points. Estimations shall be submitted when actual read meter data is missing so that completeness is achieved. Elhub makes available all meter data for the respective retailers and balance responsible within 9am.
- DSO shall supplement and update its reporting as long as needed.

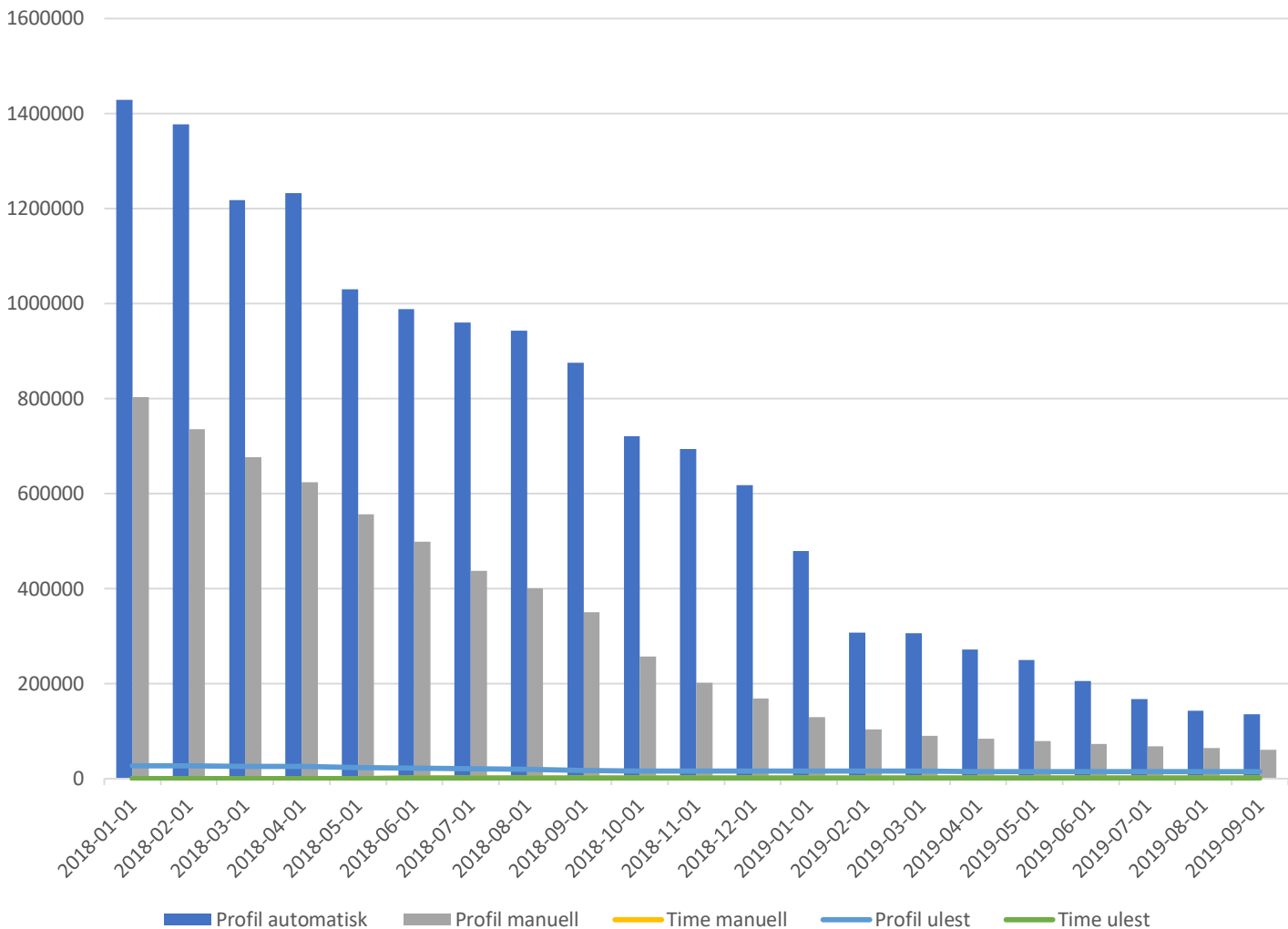
- The basis for imbalance settlement is "frozen" at D+5 and sent to eSett for imbalance settlement. All meter data shall then be "invoicing ready".
- Corrections after D+5 are subject to a monthly reconciliation settlement where Elhub is the "clearing house".

Average approved number of metering grid areas per month at different days after operational day (total 114 MGA's):

- For every day Elhub aggregates and calculates the basis for the imbalance settlement for the last 5 days, i.e. D+1 for the previous day, D+2 for the second last day, etc.
- Market parties can download metering values from D+1.
- When approved at D+5 the basis and associated metering values are frozen and considered "settlement and invoicing ready". The aggregated basis is then sent to relevant market participants and eSett for imbalance settlement.



Development of different meter types wrt collection method (remote, manual) and settlement method (hourly, profiled)



Per. 01.09.2019:

- 2.972.895 smart meters, hourly resolution
- 134.699 smart meters, profiled (blue bar)
- 60.596 old meters, profiled (grey bar)
- 505 manually read, hourly resolution
- 13.999 not metered (estimated) profiled
- 145 not metered (estimated) hourly resolution

Focus areas ahead

OPERATIONALLY

- Timely reporting and quality of metering data
 - Automatization and validation at DSO's
- Quality of end customer data and meter point information
 - Responsibility and og follow-up
- Profiled metering points
- Simplify change of supplier process
- Challenging error correction processes at DSO's
 - Now needs to be coordinated with Elhub and other market parties
- Structural industry changes
 - Aquisitions, mergers, etc.

Operational issues are handled in **Elhub Brukerforum** where DSO's, retailers, system vendor and regulator participates.

<https://elhub.no/brukerfora/elhub-brukerforum/>

STRATEGIC

- How to gain efficiency with Elhub
- Governance regarding data quality
- Costs and budget for Elhub
- 15. minutes resolution
- New grid tariff modell
- One-bill and supplier centric model

Strategic issues are handled in **Elhub Bransjeråd** where DSO's, retailers and regulator participates.

<https://elhub.no/brukerfora/bransjerad/>

elhub.no

