NWE Day-Ahead Market Coupling Project

1st Regulatory Report

July, 2012

CONTENTS

1. Introduction

Since 2006, the European Regulators Group for Electricity and Gas (ERGEG) has launched initiatives to bring together National Regulatory Authorities (NRAs), TSOs, PXs and other stakeholders to create a well-functioning Internal Energy Market (IEM). There is now a common vision for the completion of this IEM in electricity by 2014: electricity markets across Europe must share a set of common features and be linked by efficient management of interconnection capacities.

The NRAs and the Agency for the Cooperation of Energy Regulators (ACER) have published a Cross-regional Roadmap for the implementation of a single day ahead European Price Coupling and the Roadmap was approved by the Florence Forum in December 2011. The Roadmap indicates a target date of the end of 2012 for the implementation of a European Price Coupling (EPC) in North Western Europe (NWE), consistent with a parallel/sequential process of further integration leading to the achievement of the EPC by end 2014. Other regions and countries may be coupled to NWE at the start of the NWE Price Coupling provided that this does not delay the start date of NWE Price Coupling. The NWE NRAs have also indicated that the borders to neighbouring markets that are currently considered in the Interim Tight Volume Coupling (ITVC) solution should continue to be coupled under NWE Price Coupling.

The NWE Price Coupling involves the TSOs and the PXs of the countries shown in blue in Figure 1 and a full list of involved project parties can be found in Annex 1. Although the Baltic States and Poland are not involved, they are currently coupled and this coupling should not be jeopardized by new developments. The same applies for the Austrian market which is linked to the German market.

Figure 1: The countries involved in the NWE market coupling project 2012

In order to keep the NRAs of the project informed regarding the progress and solutions being developed, it has been agreed to distribute two regulatory reports and a final approval package prior to the launch of the project.

This first regulatory report provides a description of the following topics:

- the organizational structure of the project
- scope and assumptions taken for the project
- high level functional architecture (preliminary version)
- PCR and NWE
- algorithm description and TSO requirements for the algorithm
- project planning and regulatory approvals
- subjects to be handled in the 2nd regulatory report

The purpose of this report is to keep the NRAs informed and to describe the current status of the project. Solutions may change as work is proceeding. Therefore, if changes occur, the second regulatory report will give an update on subjects where necessary.

It must be recognized that a lot of information exchange has already taken place during the different ACER Electricity Stakeholder Advisory Group (AESAG) and Implementation Group (IG) meetings. Therefore it is possible that there may be overlaps with information already submitted to NRAs at an earlier stage.

Since the project deliverables are still part of the work in progress the NWE parties reserve the right to change information already distributed to the NRAs.

2. Organizational structure of the project

The TSOs and PXs involved in the NWE Price Coupling project have organized themselves according to following structure to deliver the project.

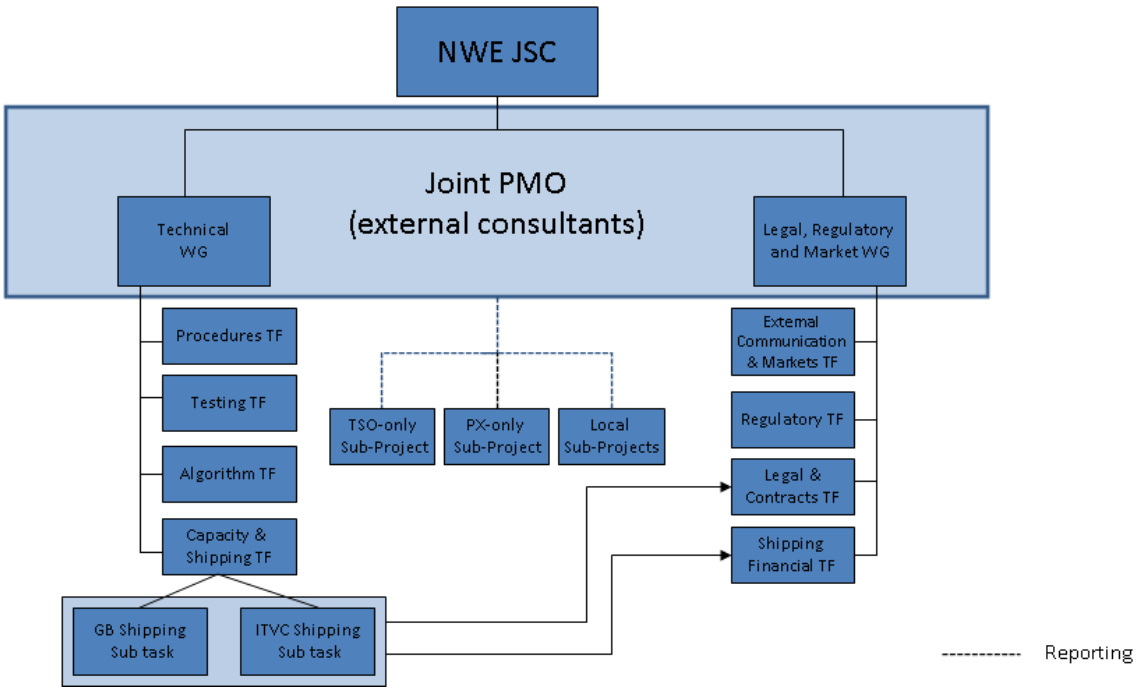

Figure 2: Organizational structure of the project

In case the NWE Joint TSO / PX Steering Committee (JSC) cannot decide or needs to escalate there is an additional body, the High Level Meeting (HLM) comprised of the CEOs of the parties involved.

The HLM and the JSC are the project bodies entitled to make decisions. The Working Group (WG) leaders are responsible for the project functioning well. They report jointly to the JSC with the Project Management Office (PMO) acting as "Secretary General", coordinating with WG leaders and ensuring the overall consistency of the project.

The project organization consists of several working groups and taskforces responsible for specific deliverables.

This project has set up communication channels with the Price Coupling of Regions (PCR) project and the Central Western Europe (CWE) flow based project to ensure that these interfaces are suitably coordinated.

2.1. Deliverables of the technical working group and task forces

The following are the deliverables of the technical WG and its task forces (TFs):

- NWE High level architecture solution
- Design of the overall joint business processes, consistently with TSO and PX business processes
- Inventory interfaces / data flows between TSOs and PXs
- Fall back solution
- Go Live plan and support

Procedures TF

- Design of joint operational procedures, based on all current procedures (CWE, Nordic, Baltic, ITVC etc.) and the revisions given by delivery of NWE Price Coupling based on PCR and including the procedures needed for GB

Testing TF

- Test scripts
- Test data
- Test planning
- End to end testing
- Test results and validation of tests

Capacity and Shipping TF

- Design and implementation of capacity submission processes, as well as result validation if applicable.
- Specification of rules and implementation of necessary changes for bilateral exchange and flow calculation (all areas impacted)
- Design and implementation of the shipping solution for CWE-Nordic and for CWE-GB as well as
- Design and implementation of the congestion income sharing process

Algorithm TF

- Validation of the implementation of TSO requirements in respect to the algorithm (PX requirements are already validated)

2.2. Deliverables of the legal, regulatory and markets working group and task forces

The following are the deliverables of the legal, regulatory and markets WG and its task forces:

External Communication & Markets TF

- Communication Plan
- Stakeholder workshop(s)
- Market parties updates – information document to update market parties on the NWE implementation and its possible impact on them.
- Press release and text proposals for other external communication

Regulatory TF

- Regulatory reports
- Final regulatory approvals for implementing the NWE solution before the launch

Legal & Contracts TF

- NWE framework agreement for the operational phase of the NWE solution including attachments
- Other contracts where applicable (e.g. Shipping, NDA, etc.) including their attachments
- Planning for contracts delivery
- Inventory of existing contracts and investigation of possible continuation of existing contracts, also taking into account hierarchy

Shipping Financial TF

- Description of the clearing and settlement process per PX / CCP / Shipping Agent for the cross border schedules.
- Description of the cross PX clearing elements and arrangements which need to be included in the contracts

3. Scope and assumptions of the project

3.1. Scope

The scope of this project concerns only the day-ahead market coupling in the NWE region in terms of a single price coupling. It concerns the design and implementation of a mechanism in the NWE Region where the market clearing prices and the PXs net positions are determined in a single step utilizing physical hourly ATC capacities. This mechanism will be an enduring price coupling solution.

The terms and conditions for the cooperation of the NWE Parties for the design and implementation of the day ahead NWE Price Coupling solution have been written down in the NWE All Party Cooperation Agreement (APCA) which is currently being signed by the parties mentioned in Annex 1. The APCA states clearly that the solution and mechanisms put in place in NWE will be easily extendable and transparent, with the overall aim to facilitate a wider price coupling in the context of the integration of the European electricity markets.

Capacity calculation for the day ahead price coupling in NWE is not in scope of this project and the NWE Intraday project will be handled separately as well.

3.2. Assumptions

The main assumption is that all systems and procedures of TSOs and PXs currently used in the CWE and Nordic-Baltic regions and the CWE-Nordic interconnections will be included as much as possible in cross border shipping and settlement arrangements. However for the CWE-Nordic interconnections several solutions will be investigated in parallel with equal priority as there is no assurance that it is feasible for the European Market Coupling Company (EMCC) to continue providing the cross border shipping and settlement services to these interconnections even for a limited period of time.

The exception to the above assumptions are the market coupling systems used in CWE, Nordic-Baltic and ITVC (via EMCC) which will be replaced by the PMB (PCR Matcher and Broker which will be operated by the PXs). This embeds the PCR Algorithm developed by the NWE PXs together with OMIE and GME which is intended to be the algorithm for EPC. For the avoidance of doubt only the necessary components for performing the price coupling are replaced, i.e. the PX Trading Systems and their interfaces versus, among others, their market participants, will remain intact as that is out of scope for NWE project and also for PCR.

Price coupling on the Sweden-Poland interconnector (SwePol) via NPS in co-operation with TGE (PolPX) and TSOs and given regulatory (NRA) support is not in scope of the NWE Price Coupling but the project must assure that this coupling will be maintained. The same applies for the bidding areas for Estonia and Lithuania, and links towards Latvia which have been established since some time within NPS Day-Ahead market (formerly consisting of the 4 Nordic countries). .

To integrate GB in the project, new systems and interfaces need to be developed on the GB side and within the GB Virtual Hub solution that has been assigned by National Grid Interconnector Limited(NGIC) to N2EX (NPS).

The project is currently verifying these assumptions and completing a high level functional architecture. In the event that the assumptions mentioned above are not valid, there might be an impact on the project duration and the launch date.

Assumptions involving parties not being a party to the APCA and the NWE project are being verified with these parties and are not confirmed at this stage. This may lead to changes in the project which cannot be foreseen at this stage.

4. High level architecture of NWE Price Coupling

This chapter contains the preliminary high level functional architecture (HLFA) and business processes of the NWE Price Coupling solution. The purpose of this chapter is to provide an overview of all the functions that are relevant for the operations of the NWE Price Coupling including the interrelationship between them. It must be stressed that the overview presented here does not by definition present the final solution, since work is still on-going.

4.1. HLFA

We define the NWE Price Coupling (PC) as the set of system components and arrangements created or adapted with the explicit aim of establishing the coupling of the day-ahead electricity markets covering the NWE region.

On a very high level the NWE price coupling process can be sketched as follows:

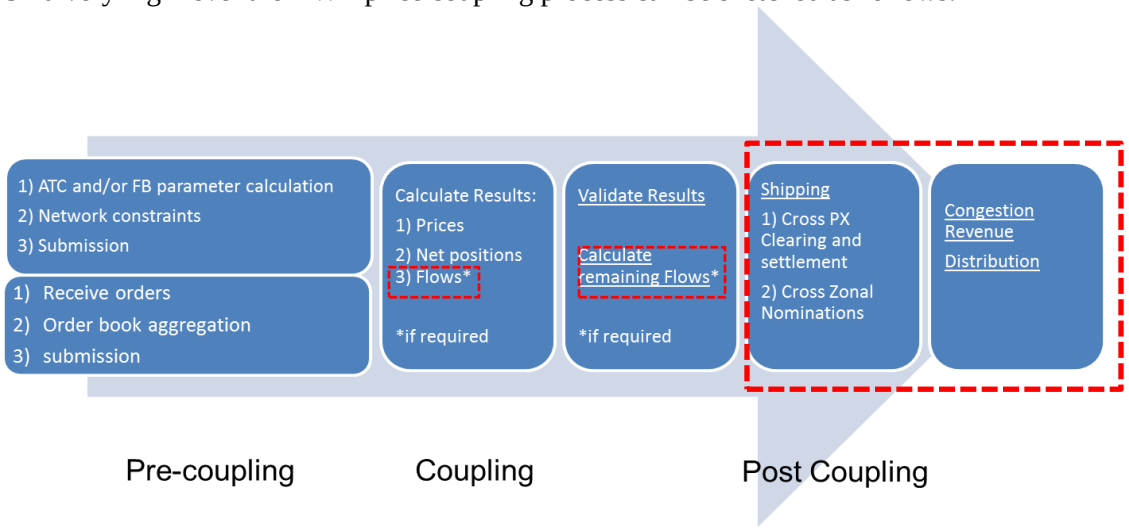

Figure 3: NWE price coupling process

Here, in particular the elements indicated in the red boxes need to be designed and developed further, before a final HLFA can be made, i.e.

- Flow Calculations
- Cross border shipping arrangements
- Congestion revenue sharing process

The options for shipping arrangements, i.e. clearing and settlement are currently being assessed in order to propose a solution for the CWE-GB and CWE-Nordic shipping.
In general the following options can be distinguished involving Shipping Agent(SA) and/or Central Counter Party (CCP).

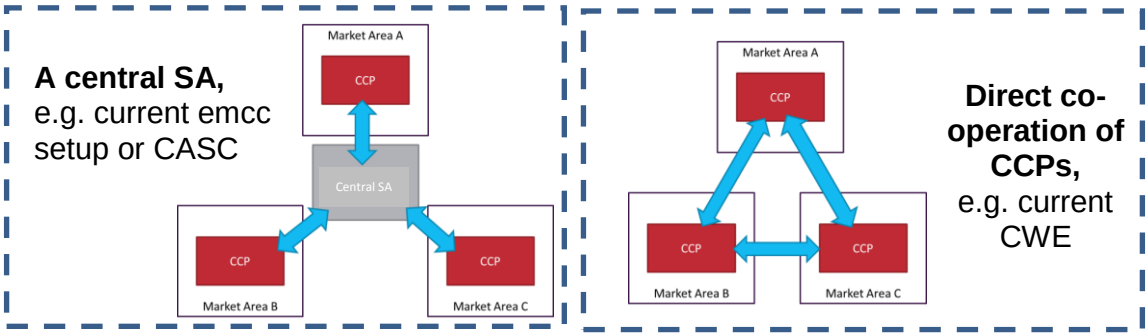

Figure 4: Overview on options for Shipping Arrangements

Furthermore, the exact way that congestion revenue sharing and, for CWE, flow calculations are going to be implemented, is still under discussion.

The price coupling process can be mapped with the generic systems as shown in the figure below:

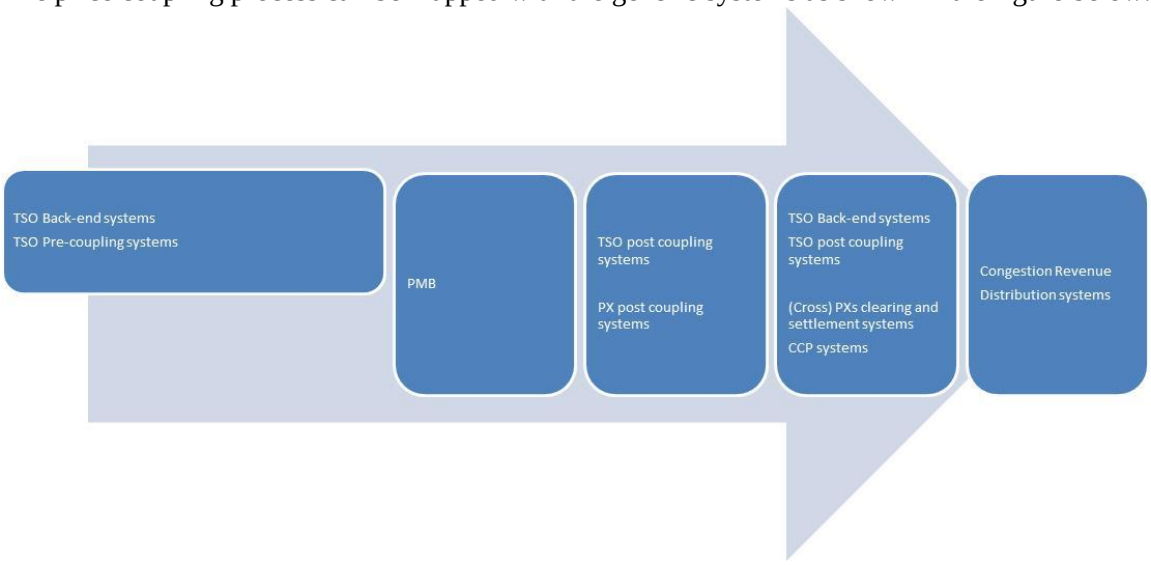

Figure 5: Price Coupling Process

4.2. The GB Virtual Hub solution

General Background

In order to facilitate market coupling, through the implicit allocation of GB cross border transmission capacity by the end of 2012 (in line with the objectives of the NWE Market Coupling project) it is necessary to design and operate an open access platform, or "virtual hub". This is because, in contrast to the electricity markets in most other NWE countries, the GB

market has both multiple PXs and multiple interconnector operators. Therefore, the virtual hub will pool GB liquidity (by allowing orders placed on each exchange to be matched through price coupling via NWE and clearing arrangements between each market operator) and, as a result, cross border capacity will be allocated by the market coupling system in a coordinated manner on behalf of participating interconnector owners. This will help to form a common reference price for electricity across all participating GB PXs.

In order to deliver the virtual hub, National Grid Interconnectors Limited (NGIC), the GB operator of the electricity interconnector to France (the "Interconnexion France-Angleterre" or "IFA") tendered for a service provider to facilitate the design, development and implementation of the solution and then also to provide an ongoing operational service. NGIC will not be a party to the PX energy transactions; all clearing, nomination and settlement activities will be arranged and managed by the service provider on its behalf. This will involve establishing contractual arrangements with PXs and CCPs (Central Counterparties) or other shipping agents (SA) as appropriate, as well as nominating flows to national TSOs and acceding to national codes as required (e.g. Balancing and Settlement Code, Connection and Use of System Code, Interconnector Access Rules etc).

In April 2012, it was announced that, following this tender process, Nord Pool Spot (NPS) had been selected to provide this solution. GB market parties will continue to enjoy their usual contractual relationship with their PX. NPS's role as hub operator will instead be to facilitate the inter-exchange transactions and will allow the coordination of the cross border capacities.

Detail

Nord Pool Spot's solution incorporates the following elements:

- Day-ahead available cross border capacity is submitted each day to NPS by the relevant interconnector operators (i.e. NGIC), with infinite capacity assumed between the NPS and APX GB hub.
- These capacities are then sent to the PCR algorithm for price calculation. Order Books (OBK) derived from any other participating PXs will be sent directly to the PCR algorithm by the PXs to avoid disturbance of competition within GB.
- As the primary currency for NWE market coupling will be Euros, NPS will distribute to the connected PXs the currency exchange rate to be used for Order Book conversion from Pound Sterling to Euro. Cross border settlement between CCPs (will take place in Euro but settlement between internal GB CCPs will be done in Pound Sterling, using the same exchange rate as in the OBK conversion.
- The PCR algorithm then calculates prices in all NWE hubs, including the two GB hubs, and net flows in/out of each hub and internal flows.
- Congestion rent (based on these flows) when received by the GB CCP involved, is paid to the interconnector owners in Euro (at this point it is focused on existing interconnectors, but the solution will be designed to accommodate any future GB interconnectors). The infinite capacity intra-GB means the two GB hub prices are identical.

- Rather than the interconnector operators doing the shipping, it is proposed that this is carried out between the CCPs as is currently the case within CWE.

The solution follows current day-ahead timelines as outlined for the NWE project.

As also stated in Chapter 3, assumptions involving parties not being a party to the APCA and the NWE project are being verified with these parties and are not confirmed at this stage.

5. PCR and NWE

The Price Coupling of the Regions project started when NPS, EPEX SPOT and OMIE signed a Letter of Intent (LOI) and a Data Sharing Agreement in June and August 2009. APX-ENDEX, Belpex and GME adhered to this cooperation in February 2010 with as a first goal to analyse and select a common algorithm which could be used for European Price Coupling (EPC).

The selection of the starting point for the PCR algorithm was performed until the beginning of 2011 and design and prototyping phase for the PCR Algorithm continued till spring of 2012.

In parallel the PCR parties started in February 2012 jointly the design and development of the so-called PCR Matcher and Broker (PMB), which are the systems taking care of the market coupling (the PCR algorithm is embedded in the PCR Matcher) and the communications and data flows between the PXs respectively.

The PCR parties signed the PCR Cooperation Agreement and the PCR Co-ownership Agreement on 13 June 2012 and the common assets like the algorithm and the broker and the matcher will now be implemented in the different regional initiatives of which NWE is one.

The NWE project will therefore closely cooperate with the PCR project and align planning and deliverables. The delivery of the PCR common assets is a PCR responsibility and is input to the NWE project, the regional implementation of the PCR common assets is however a regional responsibility.

The PCR contracts have already been communicated to ACER and to the NRA’s related to the PCR PXs.

6. Algorithm description

The price coupling algorithm for NWE will be the price coupling algorithm developed by the NWE PXs, together with OMIE and GME, in the PCR project which is a project amongst these six PXs.

The PCR algorithm is based on the Cosmos algorithm which was selected in spring 2011. The starting point of the PCR algorithm are the Cosmos specifications as applied at the time of CWE market coupling go-live. The PCR PXs have informed the relevant NRAs and TSOs on a regular basis . In order not to duplicate the information, this regulatory progress report refers to the descriptions already provided by the PCR project and are added in Annex 2 (PCR Algorithm Requirements Description) and Annex 3 (TSO requirements).

In June 2011 ACER invited ENTSO-E to assess to what extent the starting point of the PCR algorithm proposed by the PCR PXs met the TSO requirements regarding efficient allocation of capacity. This assessment report was delivered to ACER in January 2012 and concluded that the vast majority of the requirements are either already in operation in the CWE market coupling or have already been developed and extensively tested. The report (Algorithm Starting Point Assessment Report, dated 10 January 2012) has been attached as Annex 4 to this regulatory progress report.

7. Project planning and timing for stakeholder information and regulatory approvals

The timescales for the NWE project have so far only been established in a top – down approach since not all details were available for a more detailed planning. The different work groups and task forces are working over summer to finalize the design of the solution, to confirm the assumptions or find alternatives, to investigate the necessary changes and with all this information a bottom-up planning will be established. This bottom up planning will be part of the second regulatory report.

In order to have a Go – No Go decision by the end of 2012 the testing of all systems and processes for NWE Price Coupling must start by 1 October 2012 at the latest. This means that all individual and common systems and all common procedures must be finalized and approved by all the parties by this date.

Next to the project deliverables mentioned earlier, it also means that regulatory approval must be obtained in the timeframe before the end of the year. Knowing that the regulatory approval processes take minimum 3 to 4 months, and in some cases even 6 to 9 months, receiving the regulatory approvals in time will also be challenging.

Some regions require local regulatory approval processes and procedures for cross border capacity allocation and congestion management. These local procedures cannot be neglected and require varying degrees of time planning. However, in this document we focus on the joint TSO/PX project regulatory approval process for the whole NWE region. In support of this local approval process the project will establish a common approval package describing the price coupling solution.

Capacity calculation is out of scope of this project. The pre-coupling will consider the ATC values or - in a later stage and as applicable in and linked to different subsets of NWE – flow based capacity parameters as a given input. The coupling part of the project will replace the geographically separated (Nordic-Baltic vs. CWE) solutions for bid matching (prices) and capacity allocation that are currently in place with a one region, i.e. NWE solution. The methodology for this will be described and included in the final approval package. As also mentioned earlier, the arrangements related to post-coupling (e.g. shipping, etc) will stay in place as today in most of the regions (at least in CWE and Nordic-Baltic).

Given the above, the project will mainly provide a robust and extendible improvement of the current price and volume coupling solutions instead of merely an incremental change. Therefore the project proposes to have regular meetings with NRAs and other stakeholders replacing the need for a full public consultation in order not to jeopardize the target deadline. This results in the high-level communication planning as described below.

Communication timelines of the NWE project

In order to keep the NRAs and the other stakeholders informed of progress it was decided that two regulatory reports should be prepared and distributed (this report being the first with another targeted for September) as well as the final approval package (which is targeted for late October /

early November). Additionally the project will organize two stakeholder meetings to ensure that an appropriate level of stakeholder engagement takes place. The first such meeting will be held on September 26th with the second targeted for mid-December.

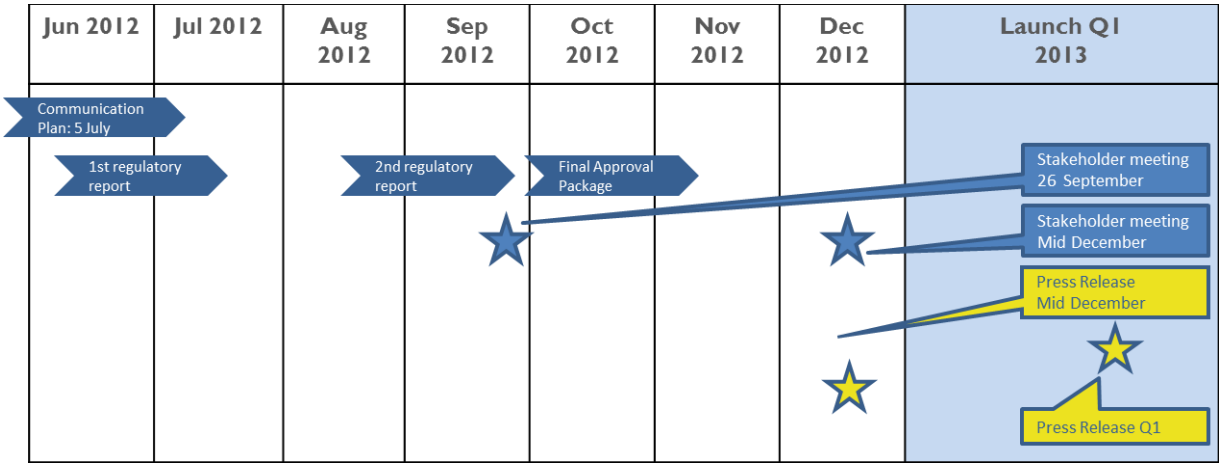

Figure 6: Indicative planning

During the first stakeholder meeting the stakeholders will be consulted on all relevant aspects of the NWE project at that stage including, amongst other things:

- The high level functional architecture of the solution
- The PCR algorithm and its features
- The status and progress of the project
- Changes for the market participants
- Next steps towards the go-live (including possibility for member testing).

8. Subjects for the 2nd regulatory report

The 2nd regulatory report is planned for end of September. This second report will give an update of subjects already handled on a high level in the first report, such as the high level functional architecture, but will go more in detail. This second report should also confirm the assumptions being verified today including the confirmation of assumptions for non NWE project parties and if not confirmed, the report will indicate alternative implementations and their planning.

Additionally following subjects will be handled in this second report:

- Bottom – up planning and milestones
- Shipping arrangements
- Normal and backup procedures
- Fall back
- Governance during operations and impact on existing contracts
- Testing (approach and planning)

Annex 1: List of parties involved in the NWE project

AFFÄRSVERKET SVENSKA KRAFTNÄT ("SVENSKA KRAFTNÄT"),a Swedish state utility, having its registered office at Svenska Kraftnät, P.O. Box 1200, SE-172 24 Sundbyberg, Sweden;

AMPRION GmbH ("AMPRION"), a company incorporated under the laws of Germany, having its registered office at Rheinlanddamm 24, D-44139 Dortmund, Germany, registered in the commercial register at the Amtsgericht Dortmund under number HRB 15940;

CREOS ("**CREOS**"), a company incorporated under the laws of Luxembourg, having its registered office at 2, rue Thomas Edison in L-1445 Strassen, registered in the commercial register at Luxembourg under number B. 104.089;

ENERGINET.DK ("**ENDK**"), a company incorporated and existing under the laws of Denmark, having its registered office at TonneKjærsvej 65, 7000 Fredericia, with Commercial Register in Erhvervs- ogSelskabsstyrelsen under number 28980671;

ELIA SYSTEM OPERATOR ("**ELIA**"), a company incorporated under the laws of Belgium, having its registered office at Boulevard de l'Empereur, 20, 1000 Brussels, Belgium, registered in the commercial register at Brussels under number 0476.388.378;

FINGRID OYJ ("**FINGRID**"), a company incorporated and existing under the laws of Finland, having its registered office at Arkadiankatu 23 B, P.O.Box 530, FI-00101 Helsinki, with Commercial Register in Helsinki no 1072894-3 ;

NATIONAL GRID INTERCONNECTORS LIMITED ("**NATIONAL GRID**"), a company incorporated under the laws of England, having its registered office at 1-3 Strand, London WC2N 5EH, registered under the number 3385525;

Réseau de Transport d'Electricité ("**RTE**"), a company incorporated under the laws of France, having its registered office at tour Initiale, 1 terrasse Bellini, TSA 41000, 92919 La Défense CEDEX, France, registered in the commercial register at Nanterre under number 444 619 258;

STATNETT SF ("**STATNETT**"), a company incorporated and existing under the laws of Norway, having its registered office at Husebybakken 28B, Postboks 5192 Majorstuen, 0786 Oslo, Norway, with Commercial Register in OSLO NO 876 067 102;

TENNET TSO B.V. ("**TenneT**"), a company incorporated under the laws of the Netherlands, having its registered office at Arnhem, Utrechtseweg 310, the Netherlands, registered in the commercial register at Centraal Gelderland under number 09155985;

TENNET TSO GmbH ("**TTG**"), a company incorporated under the laws of Germany, having its registered office at Bernecker Str. 70, 95448 Bayreuth, Germany, registered in the commercial register at Bayreuth under number 3333;

TRANSNET BW GmbH ("TransnetBW"), a limited liability company (GmbH) incorporated under the laws of Germany, having its registered office at Kriegsbergstraße 32, 70174 Stuttgart, Germany, registered with the commercial register of Stuttgart under number HRB 740510;

50Hertz Transmission GmbH ("**50Hertz**"), a company incorporated under the laws of Germany, having its registered office at Eichenstraße 3A, 12435 Berlin, Germany, registered under the number HRB 84446 B (AmtsgerichtCharlottenburg) ;

APX-ENDEX Power B.V. ("**APX**"), a company incorporated under the laws of the Netherlands, having its registered office at Hoogoorddreef 7, 1101 BA Amsterdam, the Netherlands, registered in the commercial register at 50969390;

BELPEX ("**BELPEX**"), a company incorporated under the laws of Belgium, having its registered offices at Boulevard de l'Impératrice 66, 1000 Brussels, Belgium and registered in the commercial register at Brussels, under number 0874978602;

EPEX Spot SE ("**EPEX"**), an European Company (SocietasEuropaea) incorporated under the Laws of France, having its registered office located at 5 boulevard Montmartre, 75002 Paris – France, and registered with Commercial Register in Paris under the number 508 010 501;

NORD POOL SPOT ("**NPS**"), a company incorporated under the laws of Norway, having its registered office at atVollsveien 17 B, Postboks 121, 1325 Lysaker, Norway, registered in the Brønnøysund Register under number 984 058 098;

Annex 2: PCR Algorithm Requirements Description

CONFIDENTIAL

Annex 3: TSO requirements (Annex 5 of the APCA)

ANNEX NUMBER	**5**
TITLE	**Requirements for the NWE Enduring Solution (including, inter alia, design criteria)**
PURPOSE	**To describe the high level requirements of the NWE Price Coupling solution to ensure that all TSO requirements are included in the Enduring Solution.**
TOTAL BUDGET (IF APPLICABLE)	**N/A**
APPROVED BY NWE JSC, DATE	

High level properties

The Algorithm forms the heart of the coordinated matching process within the region as a part of the market coupling mechanism defined by ENTSO-E

The single coordinated matching function is the key activity in the price coupling and its operation has a significant impact on price formation in the coupled markets. The coordinated matching process is by its nature a service of public interest to the extent that it constitutes the sole means by which implicit allocation of day-ahead cross border capacity between markets is coordinated and resolved. The available day-ahead cross-border capacity is provided exclusively for this purpose. A need for transparency and regulatory oversight of the coordinated matching function exists to ensure the public interest objectives of congestion management. The public service nature of the coordinated matching process imposes specific requirements on the market coupling solution in terms of efficiency, fairness, transparency, limitation of implementation costs and maximisation of net socio-economic surplus (i.e. maximisation of social welfare for the whole coupled area).

Congestion Management Guidelines annexed to the Regulation 714/2009 state under point 3.5 that with a view to promoting fair and efficient competition and cross-border trade, the regional coordination between TSOs shall include all the steps from capacity calculation and optimisation of allocation to secure operation of the network, with clear assignments of responsibilities. These legal requirements shall be taken into account in development of the Algorithm especially those requiring the optimisation of allocation.

In order to perform the day-ahead price coupling, an Algorithm will be used to calculate per bidding zone and for each hour the market price, net position, rejected/accepted block orders and flows on interconnectors (where appropriate). The Algorithm is crucial for the efficiency of the single market coupling. The Algorithm needs to both meet requirements from PXs taking into account the specificities of each local market, and requirements from TSOs taking into account, among others, the outputs of the applicable capacity calculation methodology(ies), the allocation specificities of each border (ramping, constraints, etc.) with the overall target of maximising economic surplus (i.e. social welfare).

Where multiple PXs operate markets in the same country (e.g. same bidding zones), the network configuration used by the PCR Algorithm will multiply the zones with the number of PXs operating in the given country, and with an infinite, (or maximum system value), ATC capacity connection between those zones. Accordingly these connections will never be congested, and therefore the prices calculated for each of these zones will always be identical.

Requirements

The requirements are categorized in the three following statuses:

(1) Already implemented - The requirement is already in the R&D Algorithm Prototype which is industrializedand/or the PMB design and will be part of the first NWE release.

(2) Implemented in first release compatible with NWE launch date – The requirement is not implemented in the R&D Algorithm Prototype, but will be part of the first NWE release.

(3) Implemented in a next release after the Go live - The requirement will not be implemented for the launch of NWE. The requirement might be subject to R&D work (if mentioned in remarks) before it can be implemented in the Algorithm and/or PMB. The planning for implementation is not determined.

Requirement type	Status	Requirement	Description
Inputs	1	**1. Algorithm Input**	Market participants submit their orders on their local PX. The Algorithm takes as daily input: • all necessary information from all local order books submitted by PXs; PXs shall determine format and content of the input regarding order information, and deal with related local complexities. • all necessary information on the network/economic constraints provided for by the TSOs; TSOs/PXs shall determine format and content of such information
	1	**2. Bids**	The Algorithm shall handle the following types of bids; hourly, blocks (including linked blocks), flexible hourly bids, profile blocks (fixed price / varying quantity).
	1	**3. Market Time Units**	The solution shall be able to handle input data with one market time

		(MTUs)	unit (not necessarily one hour).
	2	**4. Currency**	The only supportedcurrency for matching is Euro, i.e. all input and output data is in Euros. (Input orders are in Euros only. Other financial input data like flow tariffs are in Euros only. All market clearing prices are in Euros only).
Balance Constraints	1	**5. Overall balance of balancing areas**	The sum of unrounded net positions and transmission losses over all balancing areas shall be –within the bounds of a small defined tolerance - zero on any given hour in the covered region.
	1	**6. Balance of bidding zone - Area Balance**	Each bidding zone shall always be in balance on any given hour on the basis of unrounded matched quantities and bilateral exchanges.
Dynamic number of bidding zones	2	**7. Changes in number of bidding zones**	The solution shall be able to change the bidding zone configuration within 4 weeks of request from the TSOs in this respect.
Capacity constraints	1	**8. ATC constraints**	In ATC grid model, flows shall be constrained by respective ATC values in each flow direction.
	3 1 (virtual bidding area)	**9. Cumulative ATC**	It shall be possible to constrain an aggregate of lines with one global transmission limit constraint (a general bound). As an intermediate solution, it is possible to satisfy this requirement by means of the creation of a virtual bidding area (already implemented).

	1	**10. PTDF (Power Transfer Distribution Factors) Constraints**	In Flow Based grid model, flows shall be constrained by PTDF constraints. Multiple Flow Based methodologies (plain, intuitive, bilaterally intuitive) may be used for different balancing areas.[1]
	1	**11. Hybrid ATC/FB Model**	Coexistence of both Flow Based and ATC approaches in adjacent bidding zones shall be possible.
Economic Constraints	1 3 (if technically	**12. Losses**	The Algorithm shall ensure that it is possible to implement losses in the flow calculation for interconnectors within an ATC based area and for interconnectors between ATC based areas and flow based areas. Losses are not implemented between two bidding areas if no interconnector is explicitly defined. If any interconnector owner requires that losses shall be included in the optimisation on all or parts of his network, the PX is required to do so. The owner/s have the freedom to choose/negotiate at which side (exporting and/or importing) these losses will be charged for, under the possibility of it being implemented in the algorithm, which will be investigated by the PXs.

[1] For the start of the NWE market coupling it is foreseen that only one Flow Based methodology will be used.

	possible and in line with expectations of TSOs)		
Ramping Constraints The constraints shall be handled on a cable-by-cable, multiple cable and on a net-position (regional) basis.	1 (single line) 2 (combination of lines) – 3 (Long Term Nominations)	**13. Flow Ramping constraints**	It shall be possible to constrain MTU to MTU increase/decrease of flows over one line and/or a combination of lines. The ramping constraints shall take into account the nominations of long term capacity where applicable.
	1	**14. Net position ramping constraints**	It shall be possible to constrain decrease/increase net positions of a single bidding area MTU to MTU and within a day or between the last MTU from the day before and the first MTU of the next day.
Price-Network properties	1	**15. Price difference – flow tariff**	A minimum price difference between adjacent bidding areas, for using the interconnector can be implemented on any interconnector.
	1	**16. Unique Prices**	Deterministic rules are required to solve price indeterminacies.
	2	**17. Unique Flows**	There shall be deterministic rules to solve net position/flow indeterminacies.

	1	**18. Price difference and Adverse Flows in ATC / FB**	The Algorithm shall be able to: - allow adverse flows under well-defined circumstances - enforce intuitive flows either source to sink or bilateral Remark: All constraints/rules leading to selection of a potentially sub-optimal solution still need to be discussed and validated by NRAs.
Precision and Price Range	1	**19. Negative prices**	The Algorithm shall be able to deal with negative prices.
	1	**20. Rounding**	Results shall be output after rounding to the price and volume local ticks. The rule for rounding is the basic commercial rounding.
	1	**21. Precision**	Nomination tick sizes (number of digits behind the comma) differ in different PXs' bidding zones. This causes a problem if the bilateral exchange calculation harmonizes to one particular tick, whereby the sum of net positions is no longer zero. The use of losses may also affect the tick sizes of the ATC. Remark: TSOs still have to determine the final tick size and validate this concept for NWE. TSOs hope to be able to harmonize the tick size.
	1	**22. Ability to deal with non - harmonized price boundaries**	The Algorithm shall be able to deal with different price boundaries (MCPmin&MCPmax) for each bidding zone.
Objective function	1	**23. Economic Surplus**	The optimisation goal is to maximise economic surplus which is equal to the sum of the consumer surplus, the supplier surplus and

problem description			the congestion rent taking into account the network, market, economic and price constraints.
Specific HVDC Constraints The constraints shall be handled on a cable-by-cable, multiple cable and on a net-position (regional) basis.	3	**24. Minimum stable flow (MSF)**	For the HVDC cables the flow cannot be below the MSF, other than at zero. The MSF will be given for each HVDC interconnector. The allocation shall take into account the nominations of long term capacity where applicable.
Non-functional/ qualitative requirements	1	**25. Reproducibility/Robustness/Reliability**	The Algorithm shall at any time be able to reproduce the same results with the same input data and with the same number of iterations The Algorithm shall be robust, reliable and it shall be resilient to unexpected data configurations, i.e. it provides satisfying results in all cases, including in all special situations such as non-crossing of bids and offer curves, orders' curtailment, max/min prices, price and volume indeterminacy, etc. The Algorithm shall always produce a unique result, i.e. price and volume indeterminacy shall be resolved. The Algorithm shall use proven technology (e.g. proven third party software).

			The Algorithm shall be available at all times when required shall perform according to the requirements in all circumstances. The Algorithm shall be well structured, documented and easily maintained. The Algorithm shall allow for partial and full decoupling, depending on the reason causing the decoupling.
	1	**26. Performance**	The performance of the algorithm will be monitored over time and compared to the performance indicators agreed upon between the TSOs and PXs. If the performance is not satisfactory, the TSOs may ask for an improvement of performance.
	1	**27. The Algorithm source code shall be well structured and well documented**	The Algorithm source code shall be well structured and well documented.
	1	**28. Non-discrimination**	The Algorithm shall not contain any calculation rules discriminating market parties versus others. Deterministic rules are arbitrating in case of solutions with equivalent social welfare.
	1	**29. Winter/Summer time**	The Algorithm shall be able to deal with clock changes related to winter and summer time changes (i.e. Algorithm supports 23, 24 or 25 hours).
	1	**30. Calculation time cut-off**	The Algorithm always finds a solution within the imposed time limit and that, in case calculation time is exceeded, the best available solution is chosen. The total processing time of the

			Algorithm shall be as short as possible.
	1	**31. Transparency**	TSOs request transparency and auditability. The calculation process of the Algorithm, including prices and allocated capacities resulting from this process, have to be transparent, auditable, and explainable. It shall be possible to provide reports and other monitoring material towards TSOs and PXs.
	1	**32. Fairness**	The Algorithm shall be fair, meaning that the calculation rules shall be neutral and shall not discriminate nor favour any orders, order types or order origins.
	1	**33. Simplicity**	The complexity of the Algorithm does not prevent its efficient implementation.
Outputs	1	**34. Algorithm outputs**	The objective of the Algorithm is to determine for each bidding zone and each market time unit how much electricity to export or to import (i.e. prices, net position at a minimum and power flows if requested), and to determine which block orders can be accepted. The output of the Algorithm is: Prices: - prices in EUR per bidding area (unrounded, rounded); - shadow prices of critical branches (needed for FB model); - unconstrained prices for specified Nordic regions[2]; Quantities:

[2]Indirect output of the algorithm calculation. This is only an output after rerunning the calculation without any network constraints.

			- net positions, which is defined as the difference between matched local supply and demand(rounded and unrounded); - cross zonal flows (into and out of the interconnector) and/or margin used under flow based; - total executed quantities; - block execution (paradoxical rejection if any); - complex order execution (paradoxical rejection if any); Calculation results: - economic surplus;
	2 (under current working assumption, i.e. current requirement description is valid)	**35. Flow calculations**	The solution shall be able to calculate the flows, but also the net-positions (the NWE net positions and CWE net positions) and/or bilateral exchanges (BEC) according to TSO requirements, for individual TSOs if required. PXs shall therefore develop a post-processingmodule in the Algorithmcapable to perform these flow calculations on each interconnector (ATC)/critical line(FB), respecting local rules. Each TSO will have to indicate to the PXs if they intend to use the flow calculation functionality of the MC system.

Annex 4: Algorithm Starting Point Assessment Report

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