PCR
PRICE COUPLING OF REGIONS

Euphemia performance

European stakeholder committee
Date: SEP 2015

Supported by

Market Parties Platform (MPP) concerns

- MPP expressed concerns regarding the quality of solutions found by Euphemia
- To regain confidence they request an objective evaluation of the quality of the solution: the “optimality gap”
- In the opinion of MPP there is a link between sub-optimality and PRBs and they indicate that:
    - PRBs are understood to exist as a consequence of the indivisibility requirement;
    - There may exist “false” PRBs: rejected in-the-money blocks that could have been accepted and result in a better (higher welfare) solution
    - MPP asks for more transparency on optimality, to prove the absence of false PRBs.

PCR
PRICE COUPLING OF REGIONS

Complexity of the problem

Geographical scope

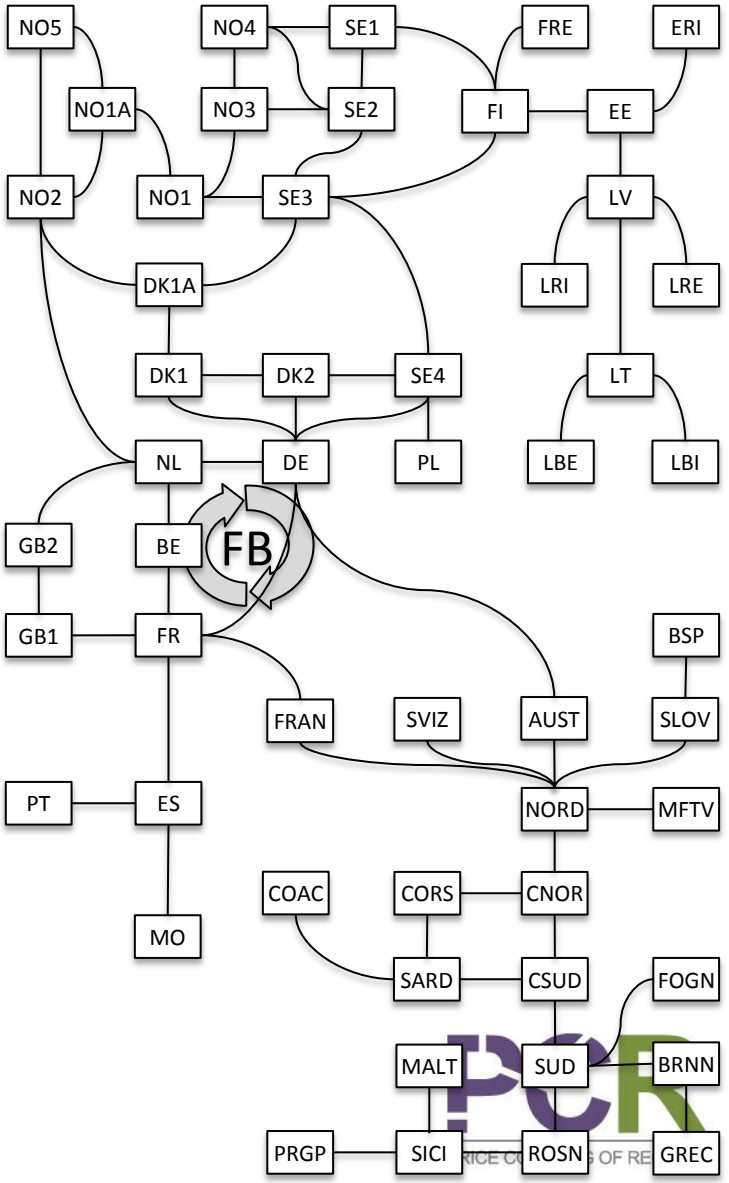
- Over 50 bidding areas interconnected, all part of the overall market coupling problem

Network constraints:

- CWE intuitive Flow Based
- Line/Lineset ramping
- DC cable losses

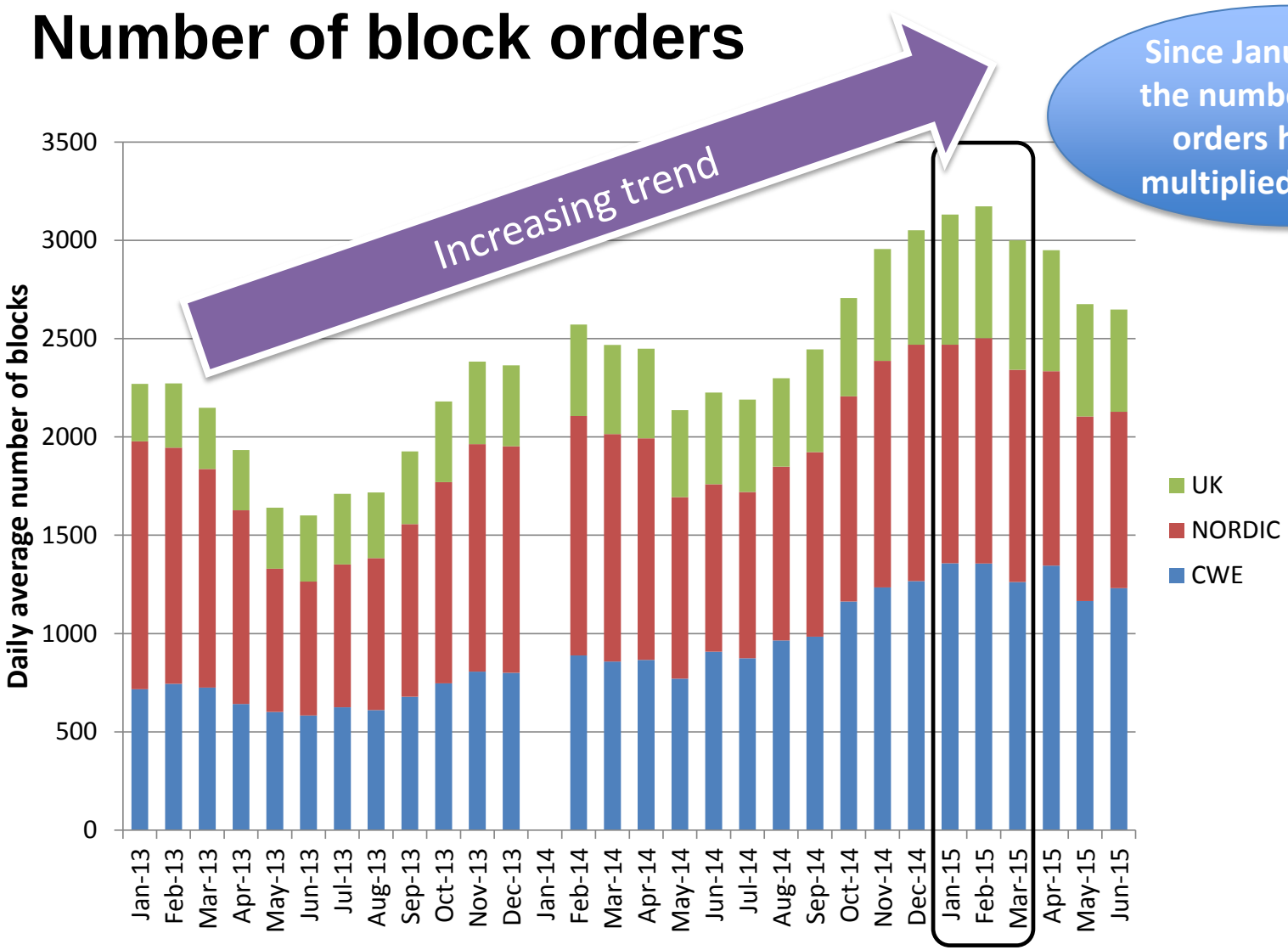
⇒The problem is solved globally by the algorithm, taking into consideration all constraints at the same time.

⇒The problem is very complex, and its complexity is continuously growing (see next slides).



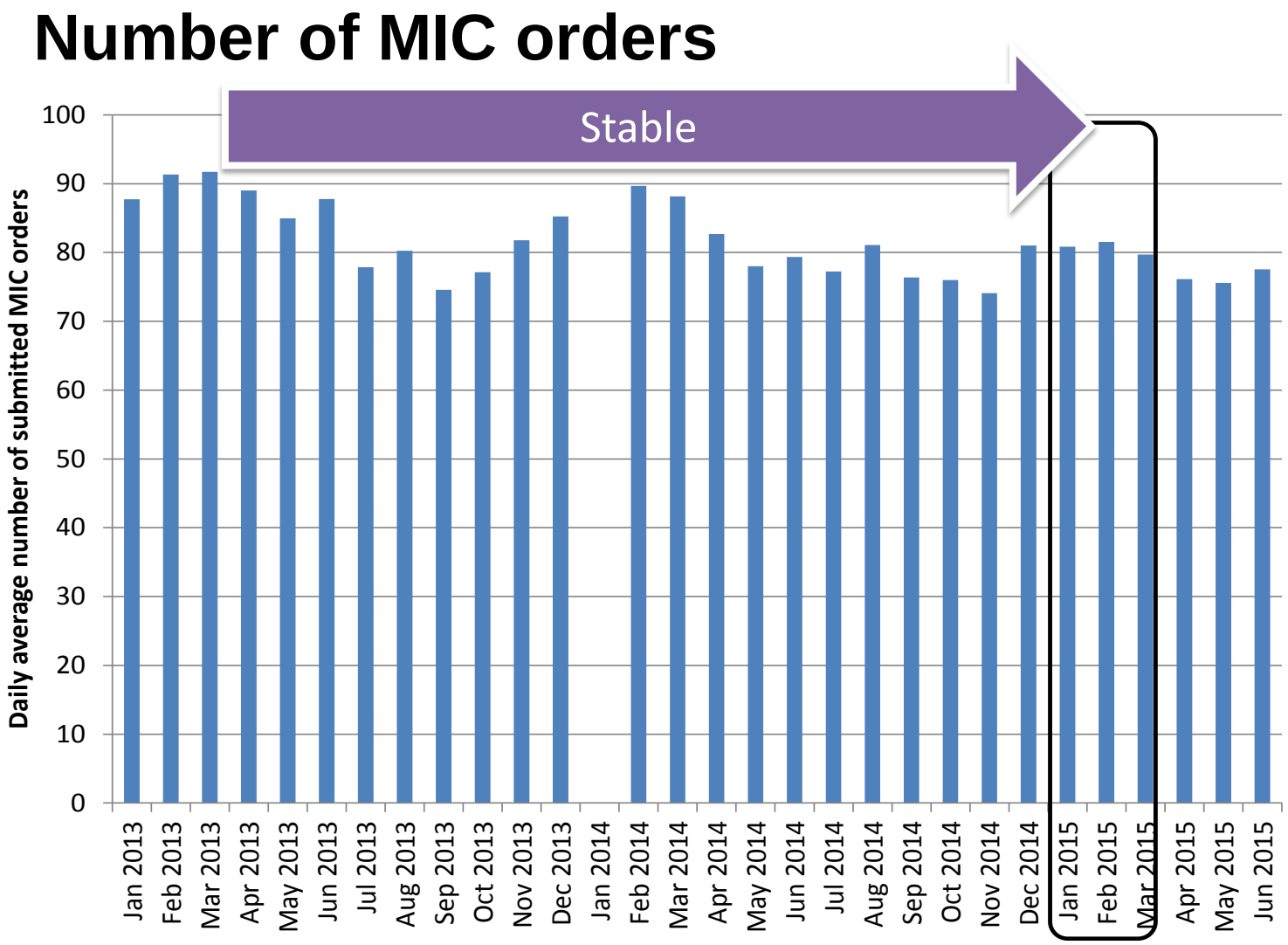
Complexity of the problem

Number of block orders



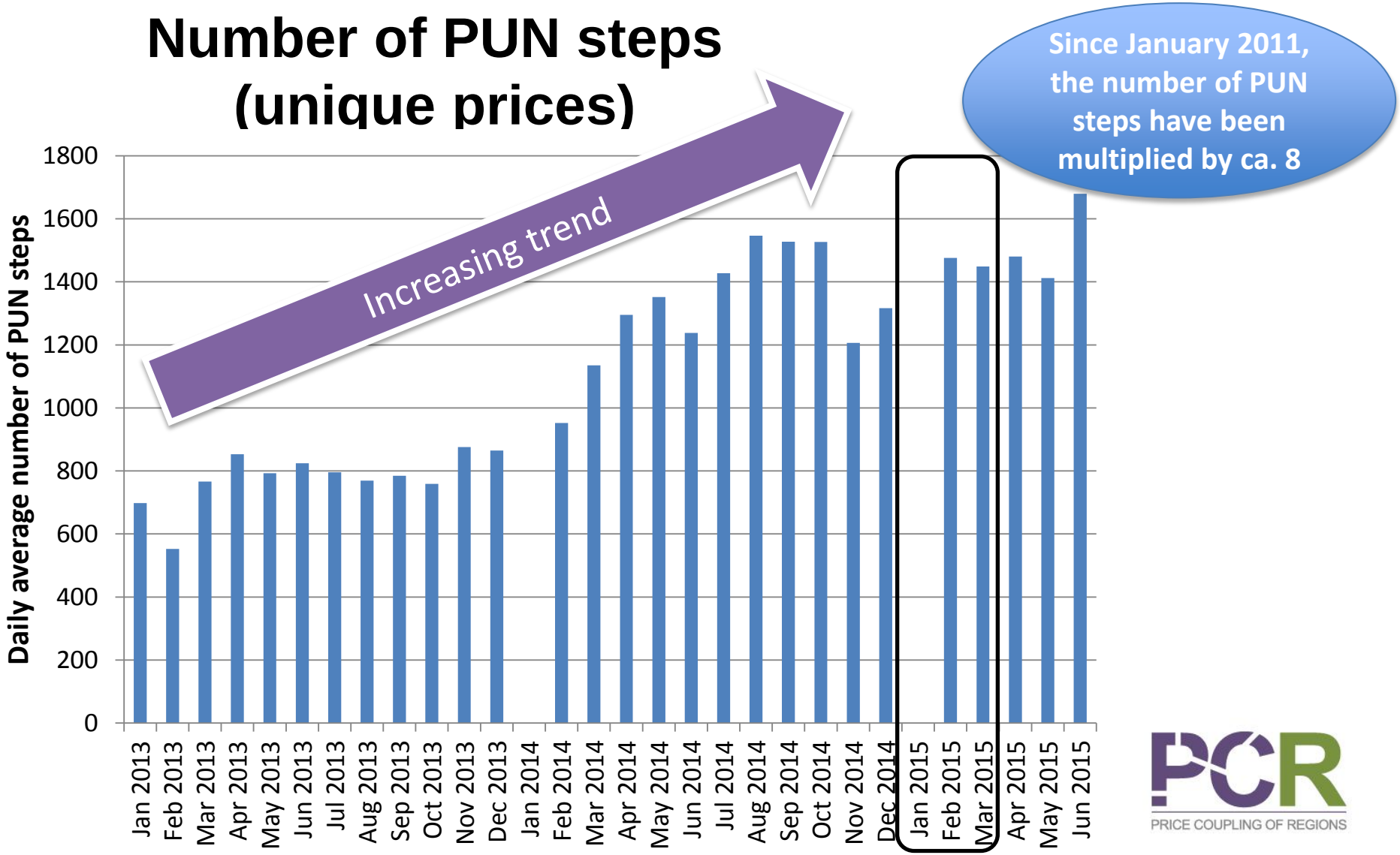
PCR
PRICE COUPLING OF REGIONS

Complexity of the problem



PCR
PRICE COUPLING OF REGIONS

Complexity of the problem



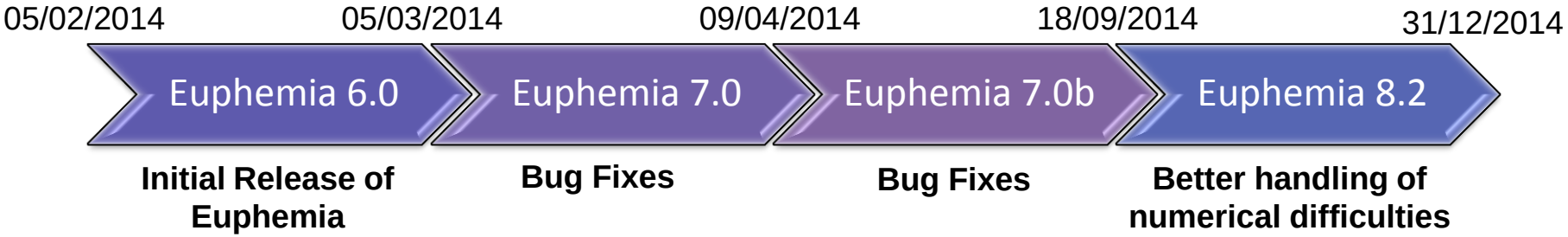
PCR
PRICE COUPLING OF REGIONS

Euphemia performance

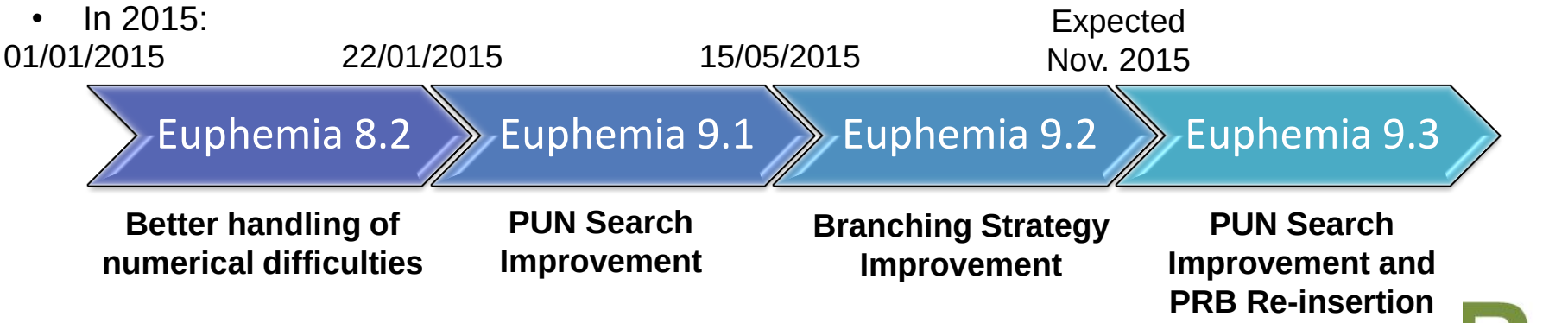
Euphemia Development

- In order to cope with the expending perimeter and the increasing number and complexities of the products that are used, significant performance improvements have been implemented within Euphemia.*

- In 2014, 4 releases of Euphemia have been put in production :



- In 2015:



PCR
PRICE COUPLING OF REGIONS

Short and medium term improvements

- Euphemia (E9.3) expected Beginning November:
  - PUN speed-up (complementary to improvements made in E9.1 and E9.2);
  - PRB reinsertion: heuristic to locally improve solutions by trying to reinsert PRBs back into the solution;

- For the 2016 releases of Euphemia subsequent improvements can be made:
  - PRB reinsertion / local search heuristics could be further developed;
  - Heuristic MIC filtering
  - Address time lost due to numerical difficulties
  - Parallel processing
  - Conceive better branching strategies

- The welfare gap may improve, but there is no guarantee of the level of improvement.
- To obtain zero or near zero welfare gaps each day, more radical changes would probably be required. Some ideas are discussed in subsequent slides.

PCR
PRICE COUPLING OF REGIONS

Long term improvements

More radical solutions could involve to alter the market design to ease the complexity of the problem.

This could imply at least three possible approaches:

1. Reduce the amount of blocks types and other complex products allowed per participant and market (bidding zones).
2. Reducing the range of products treated in Euphemia
3. Relaxing the linear pricing rule (accept that the result has more than one price per bidding zone and time period)

Following slides gives some more insight in to 2 and 3

PCR
PRICE COUPLING OF REGIONS

Harmonization of products

- **One such product could possibly be the new Thermal Order, modelling a thermal unit**
  - Minimum stable generation (similar to minimum acceptance ratio)
  - Load gradient (similar to complex orders)
  - Start up profile and cost (similar to MIC fixed term)
  - Minimum running time when started, minimum down time
  - Shut down profile (similar to scheduled stop)
  - Must run conditions (capacity not available to the market)
  - Flexible in time (similar to exclusive groups)
  - Variable cost expressed in €/MWh
  - Etc.

- **Caveat**
  - This product may actually bring additional complexity compared to (smart) blocks or MICs.
  - This product would work **only** if 1 Thermal Order would replace multiple blocks.
  - According to our provider the Thermal Order would also need us to consider a more radical market design and pricing regime change (next slide)

Van Vyve model

- An alternate market design is discussed in [2011] *Linear prices for non-convex electricity markets: models and algorithms, M. Van Vyve;*
- It builds on experiences from electricity markets in both US and Europe
- The model drops some of the current requirements in the current market design, and becomes more computationally tractable;
  - The proposal does not respect the CACM one price per bidding zone and time unit requirement
- Preliminary thoughts of our algorithm provider (N-Side) are that such a model could be solved to (near) optimality with a proven optimality gap.
  - If confirmed after extensive modelling and testing in pan-Europe or MRC production like scenarios, this solution could possibly would address the main concerns expressed by Market Parties Platform

PCR
PRICE COUPLING OF REGIONS

Van Vyve model - Caveats

- The proposed model however does introduce a series of significant changes to the current European market design:
  - Out-of-the-money orders can be accepted, i.e. paradoxically accepted orders;
  - These orders could be compensated via “uplifts”: some of the surplus generated by in-the-money orders would be funneled to these loss giving orders.
  - Effectively this is a deviation from the single price per bidding zone and time period requirement of CACM: some orders receive uplifts on top of the clearing price, others pay uplifts on top of the clearing price. The net effect is that different orders pay/receive a different price even when they are in the same Bidding Zone;

PCR
PRICE COUPLING OF REGIONS

Next steps

- The scope of the 2016 Euphemia releases will include some incremental improvement (i.e. more PRB reinsertion and some MIC filtering) and a meaningful improvement (multi threading) but proven optimality is not guaranteed

- PCR parties seek assurance that PCR can be considered as the future day-ahead pan-European solution under CACM, and as a consequence any further material investment (since CACM entered into force) in the common PCR algorithm, systems, procedures, market rules and contracts will be recoverable according to CACM

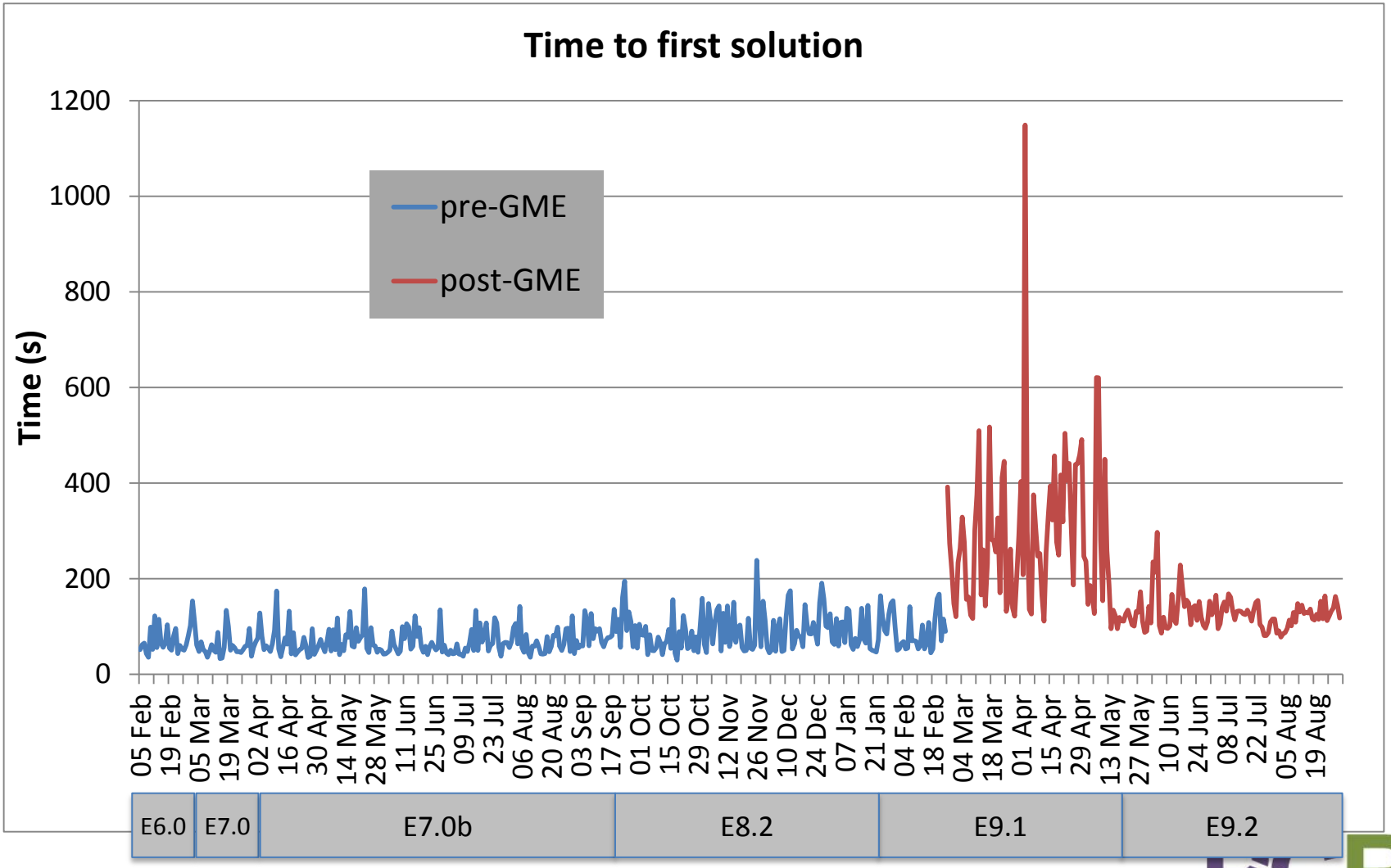
- During 2016 it could be possible to establish prototypes, to assess the impact of both of these revolutionary proposals:

  - The introduction of the thermal orders to substitute blocks and complex orders
  - Another even more revolutionary change could be brought with the introduction of the altered pricing scheme, **not respecting the single price per bidding zone requirement**

PCR
PRICE COUPLING OF REGIONS

Statistics - PCR Algorithmic Performance

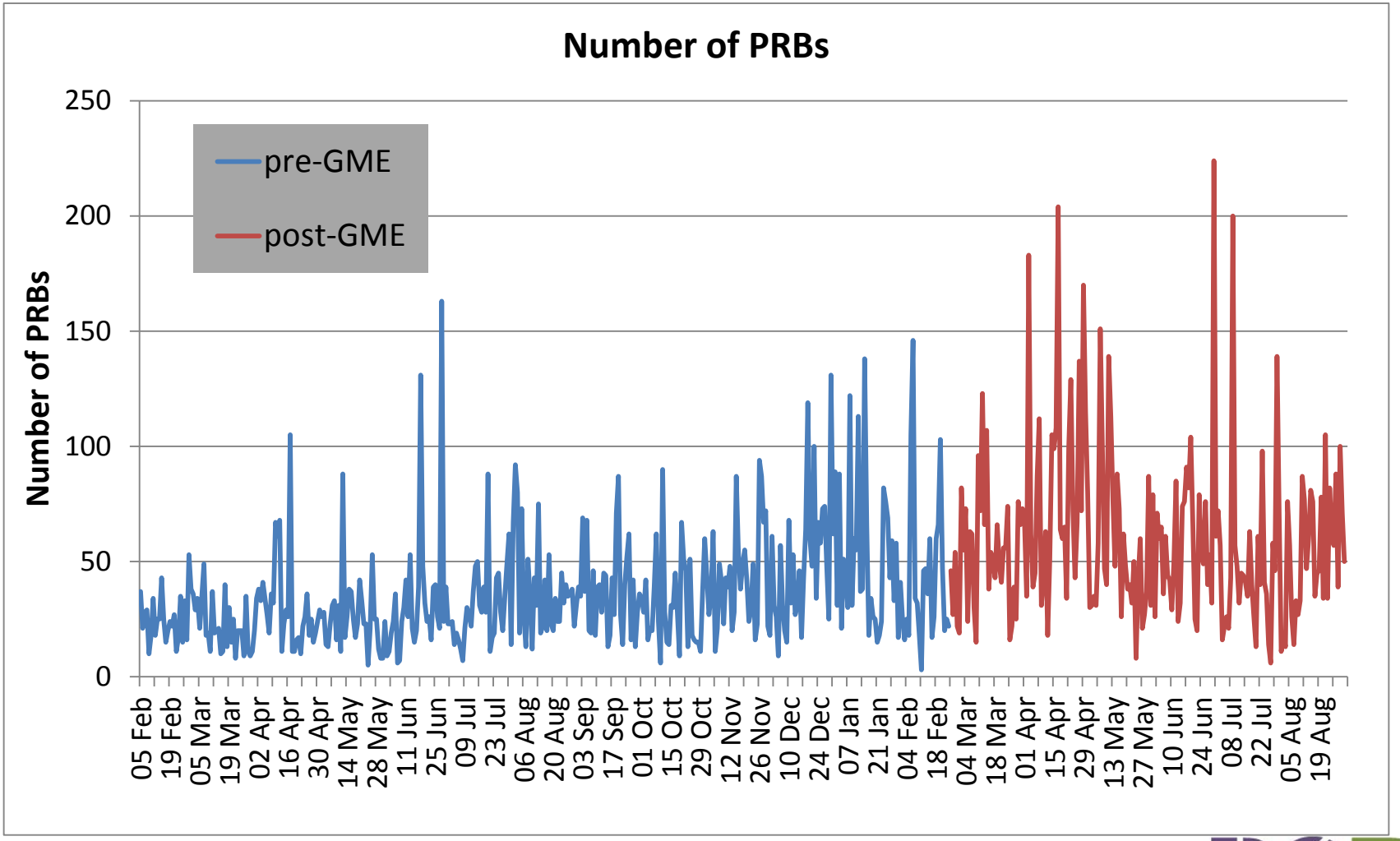
PCR algorithm performance update – Time to first solution (on MRC scope)



PCR
PRICE COUPLING OF REGIONS

Statistics - PCR Algorithmic Performance

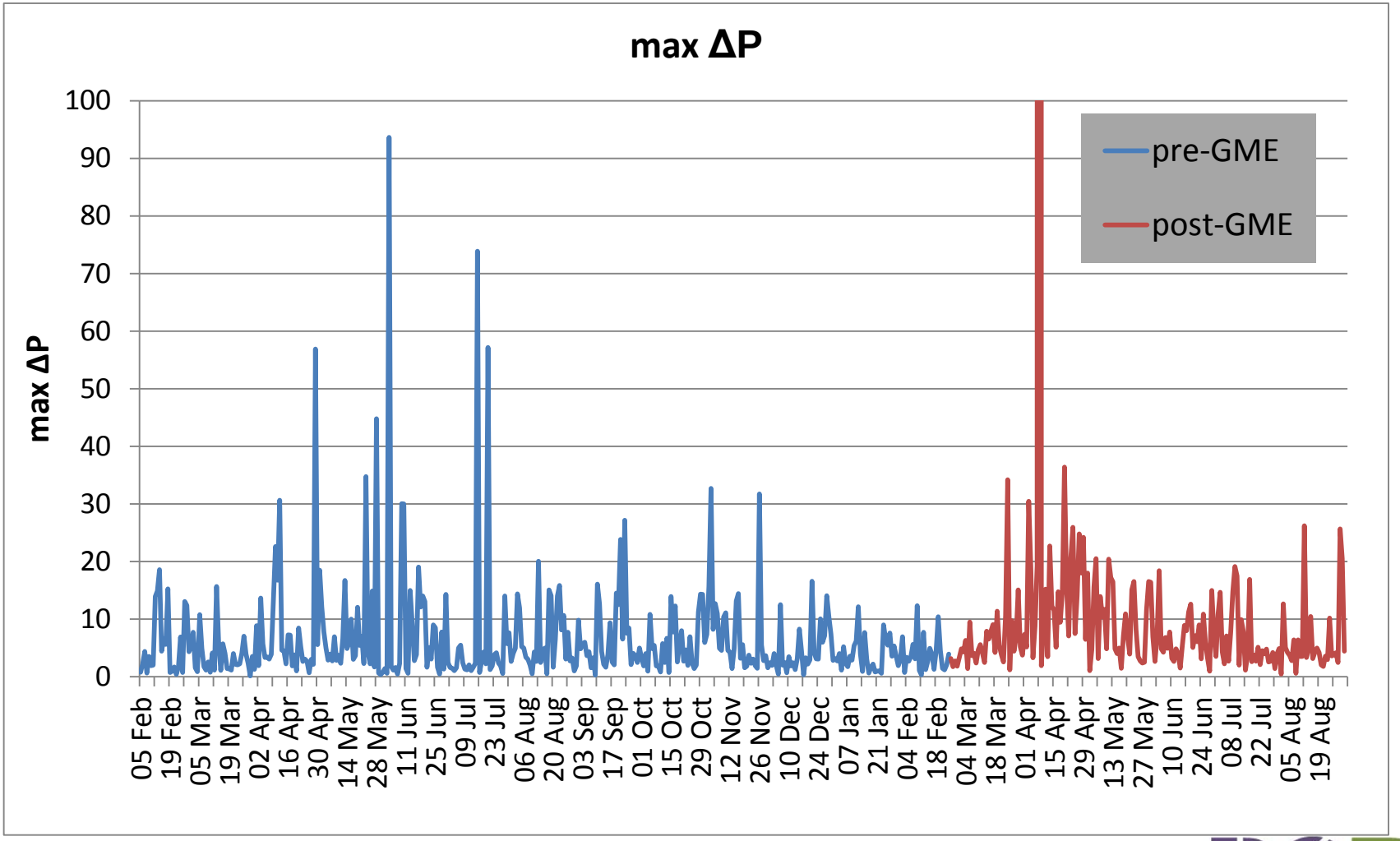
PCR algorithm performance update – Number of PRBs (on MRC scope)



PCR
PRICE COUPLING OF REGIONS

Statistics - PCR Algorithmic Performance

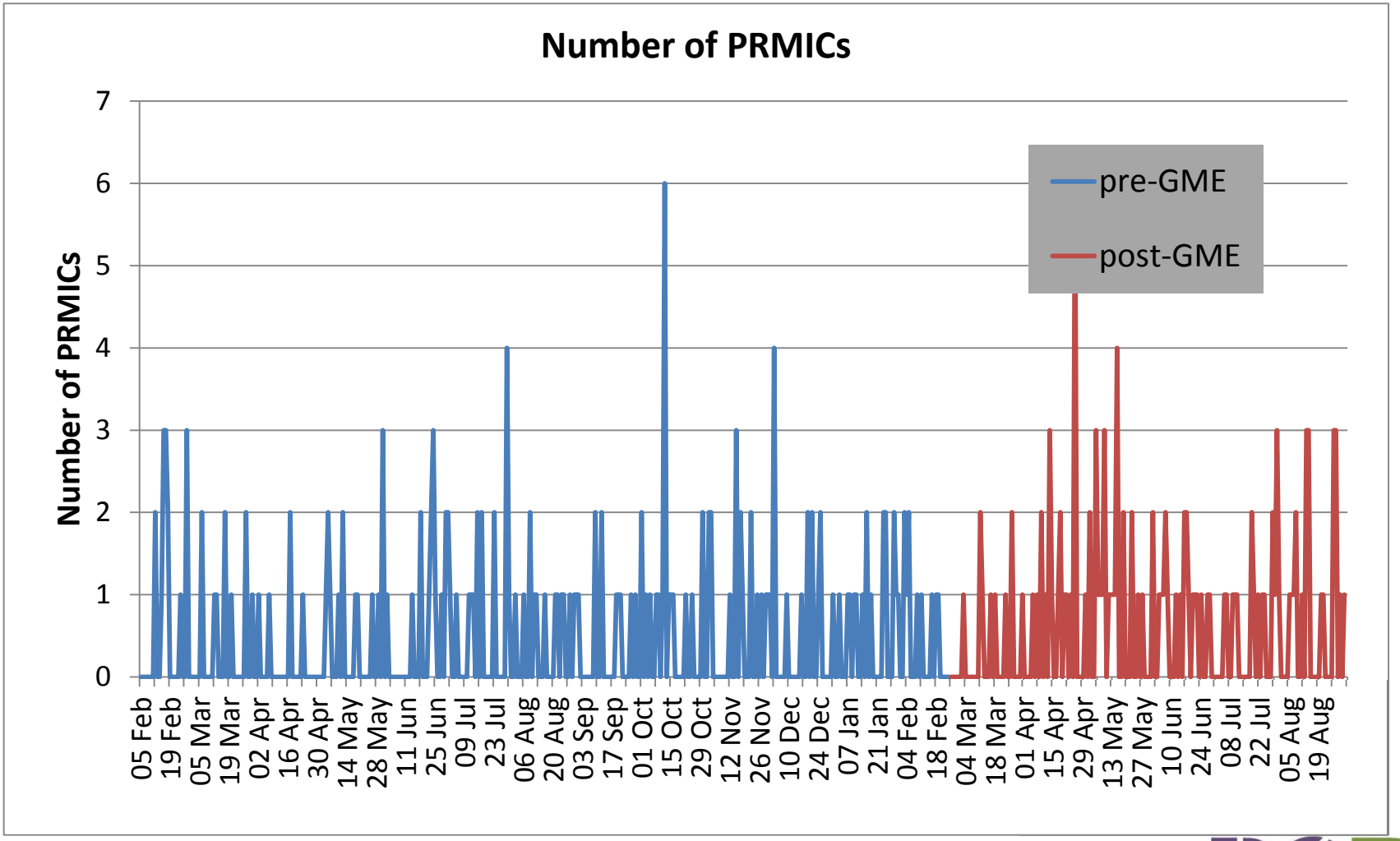
PCR algorithm performance update – Max ΔP (on MRC scope)



PCR
PRICE COUPLING OF REGIONS

Statistics - PCR Algorithmic Performance

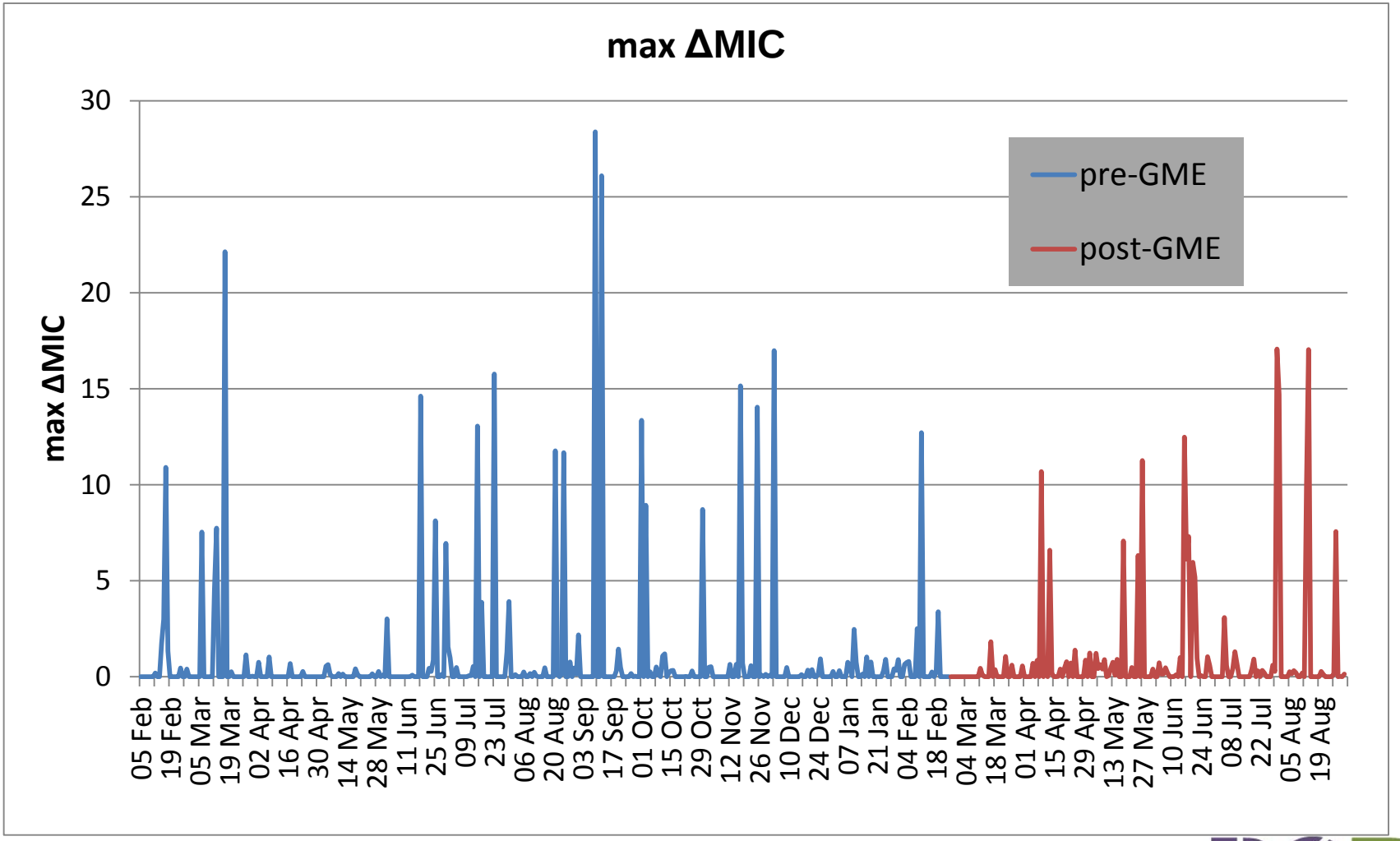
PCR algorithm performance update – PRMICs (on MRC scope)



PCR
PRICE COUPLING OF REGIONS

Statistics - PCR Algorithmic Performance

PCR algorithm performance update – Max ΔMIC (on MRC scope)



PCR
PRICE COUPLING OF REGIONS