Statistical analysis of the deployment potential of Smart Grids solutions to enhance the hosting capacity of LV networks

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1. Introduction

2. Methodology

3. Deployment potential of VRDT and reactive power control

4. Feeder classification

5. Conclusions

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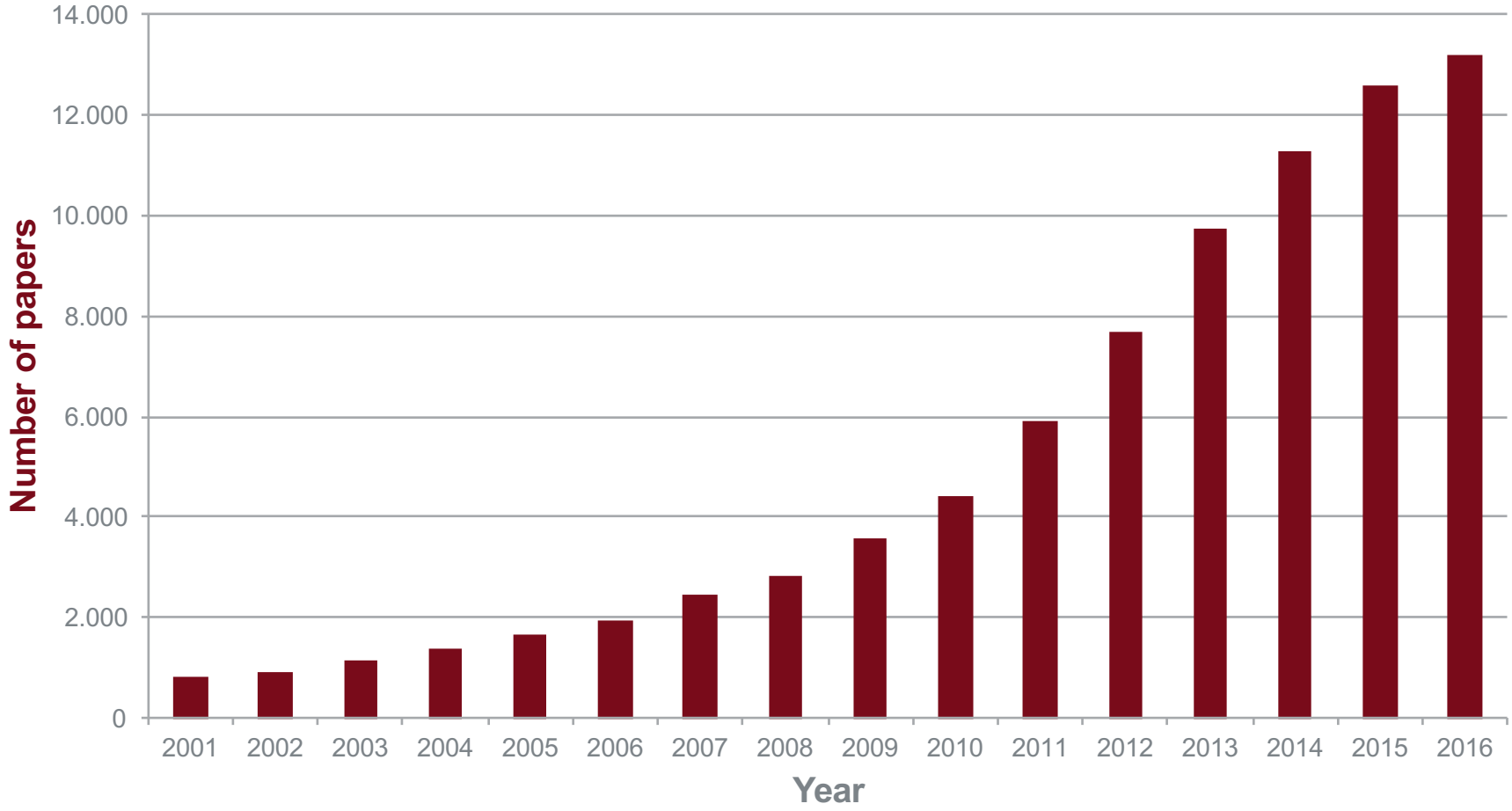
Papers \ "photovoltaic" & "reactive power"



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Project IGREENGrid

IGREENGrid

Guidelines

Smart grids solutions from pilot projects

DRES integration

Hosting capacity enhancement

Technical requirements for DRES

Scalability and replicability

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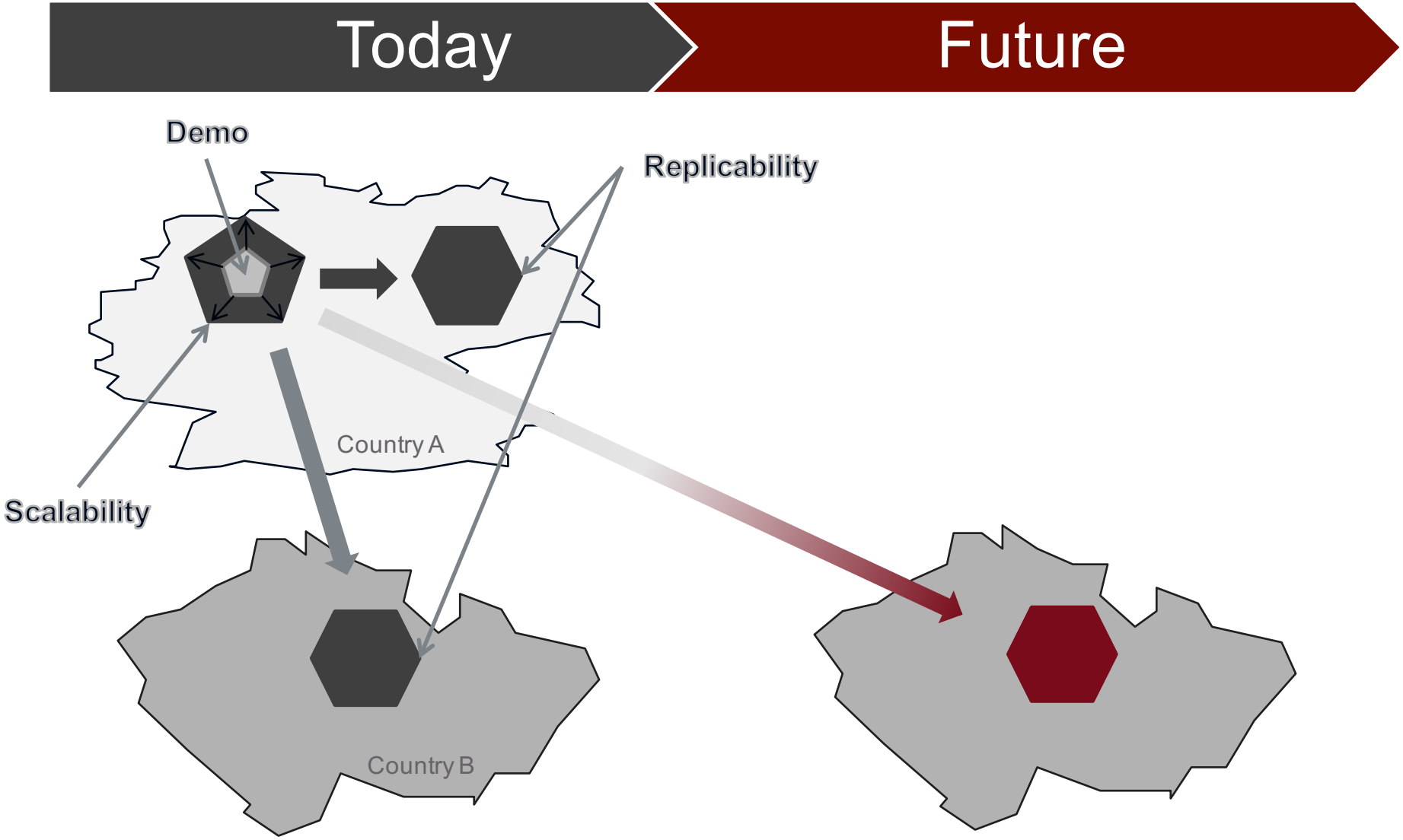
Scalability and replicability analysis - concept



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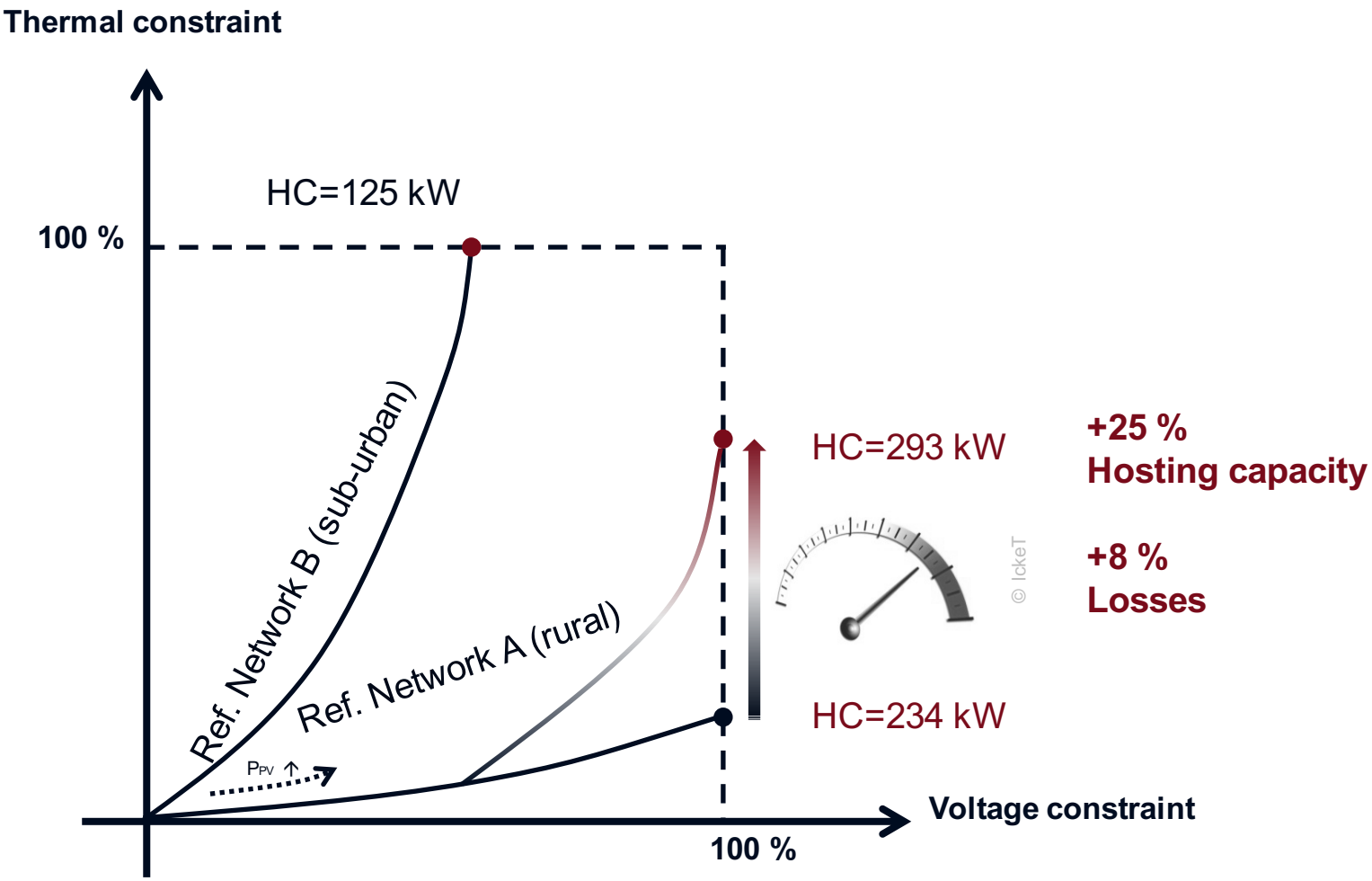
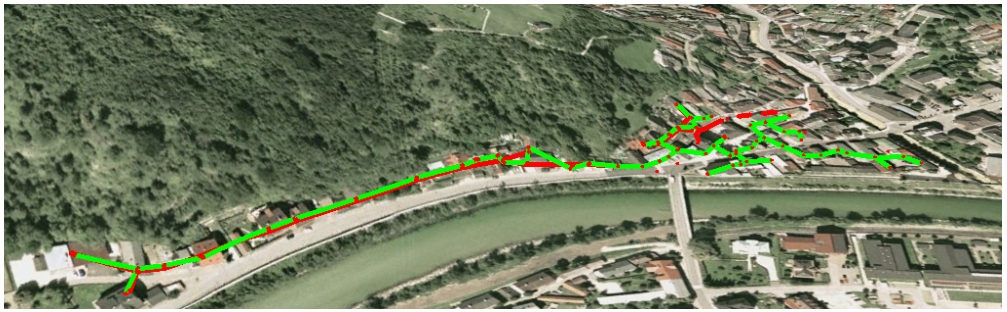
Increase of the hosting capacity: textbook illustration



Data basis (~37.000 LV feeders)



- Parameters (>80)
  - ElDist, GeoDist
  - Impedance, R/X
  - Equivalent sum impedance
  - Equivalent load location
  - Number of nodes, loads, lines
  - Average Number and Distance to Neighbours
  - Mesh factor
  - Feeder rated current (min,mean,max)
  - …
- Results
  - Hosting capacity
    - DRES scenarios: uniform / end of feeder / weighted
    - Controls: without / cosφ(P) / Q(U)

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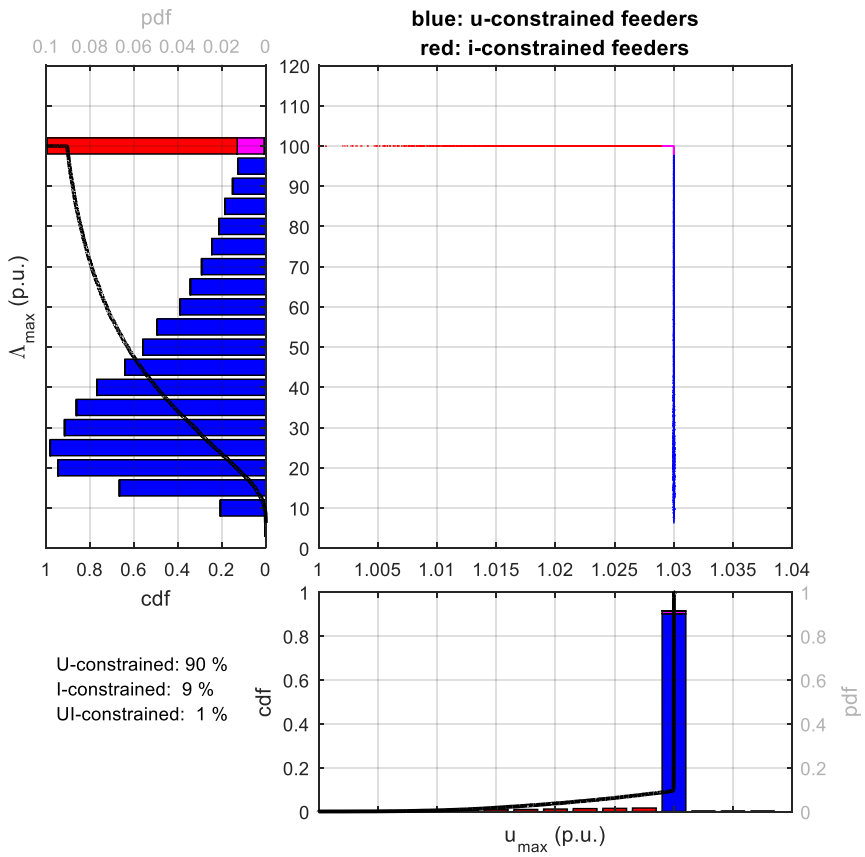
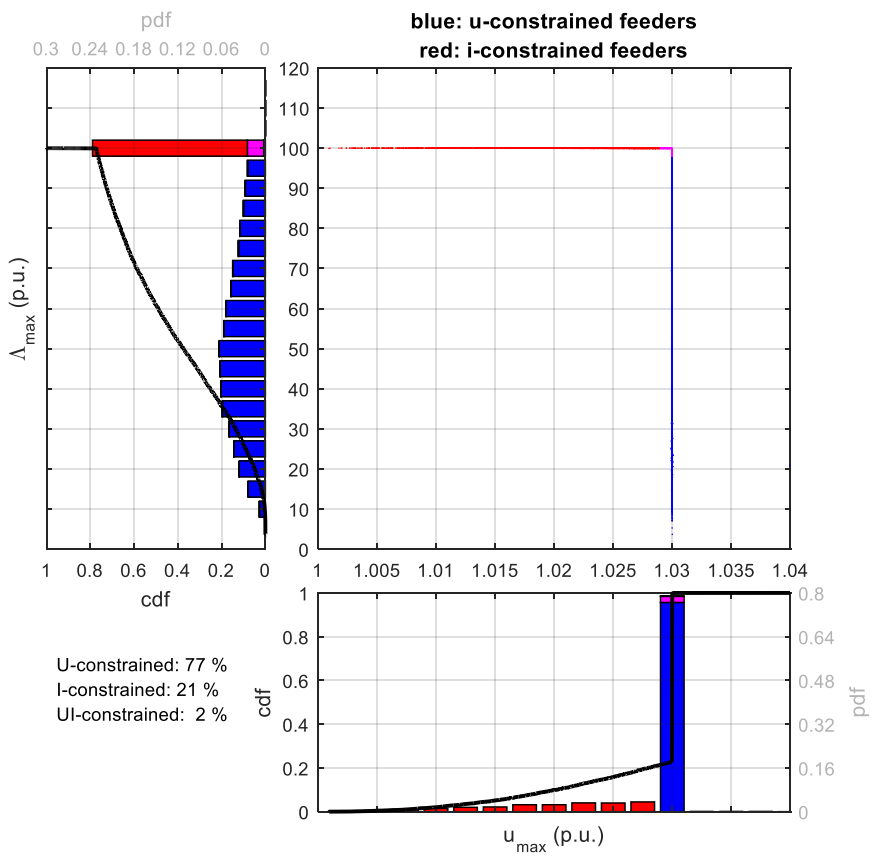
Feeder characterisation (~11.000 LV networks and 37.000 LV feeders)

Netz Oberösterreich (NOÖ)



Salzburg Netz (SBGN)



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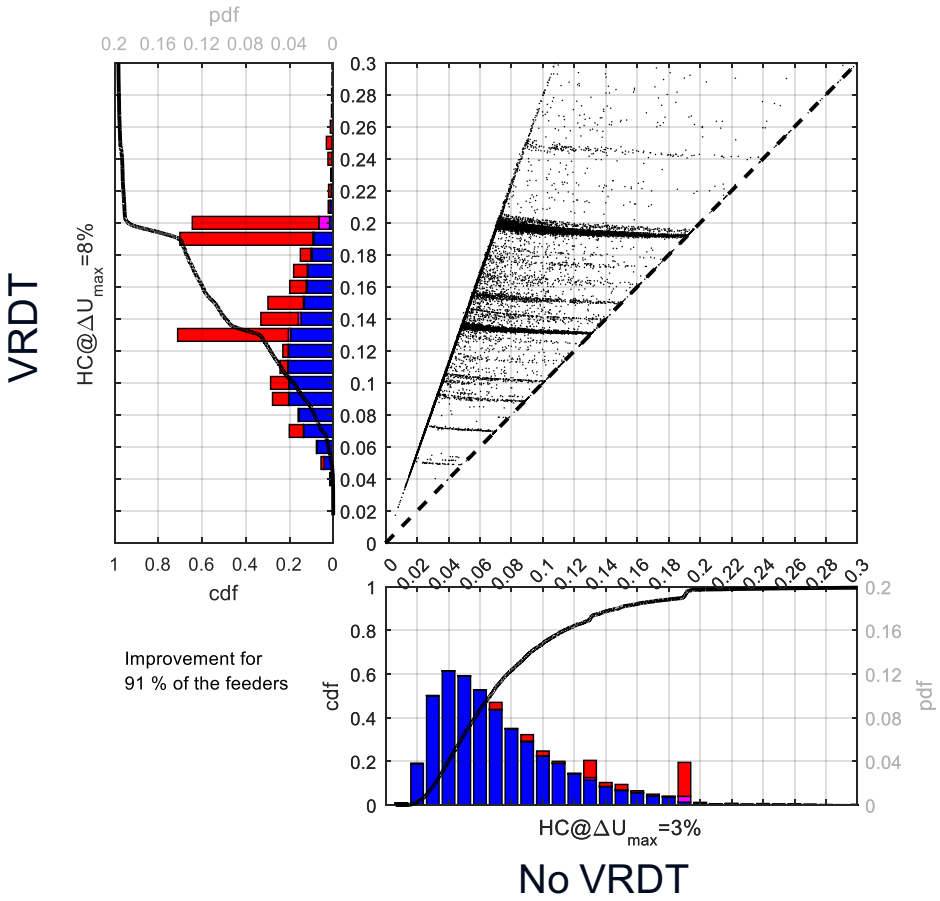
Potential of *Voltage Regulated Distribution Transformers (rONT)*



- NOÖ: benefit for 43% of feeders, +179% hosting capacity
- SBGN: benefit for 21% of feeders, +179% hosting capacity

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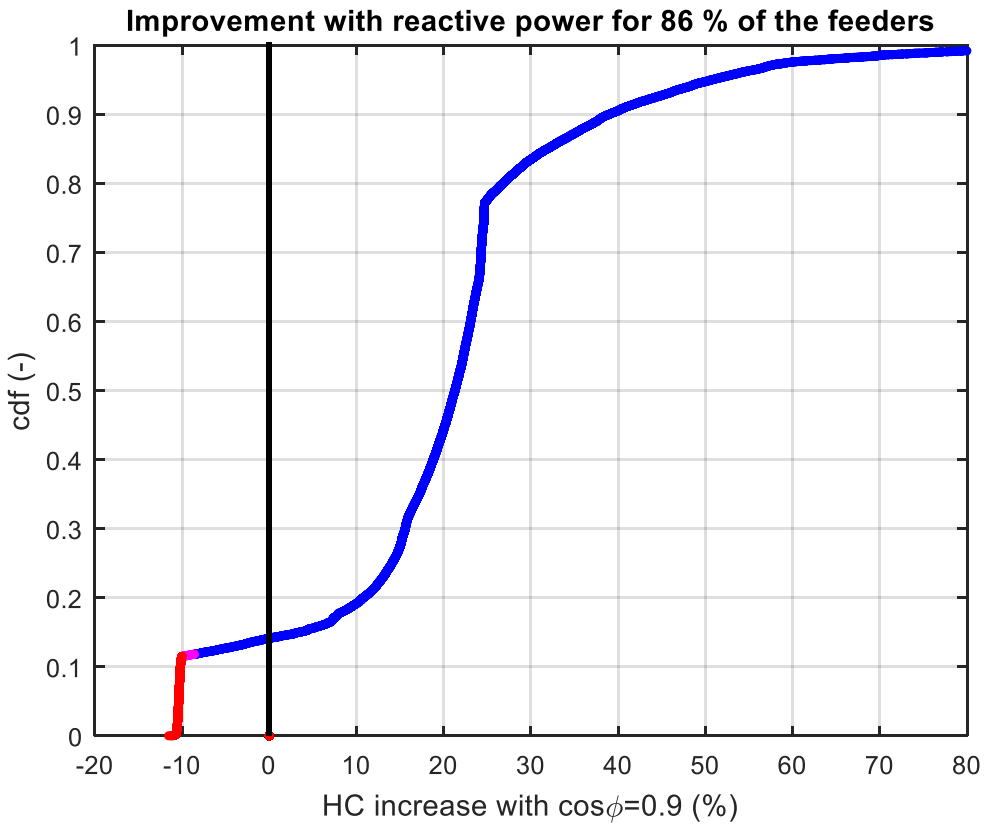
Potential of reactive power control



- Potential for NOÖ:
  - benefit for 81% of feeders
  - average benefit: +25% HC
- Potential for SBGN:
  - benefit for 61% of feeders
  - average benefit: +23% HC
- Q(U) vs. cosφ(P)
  3 % less effective for most (95%) feeders

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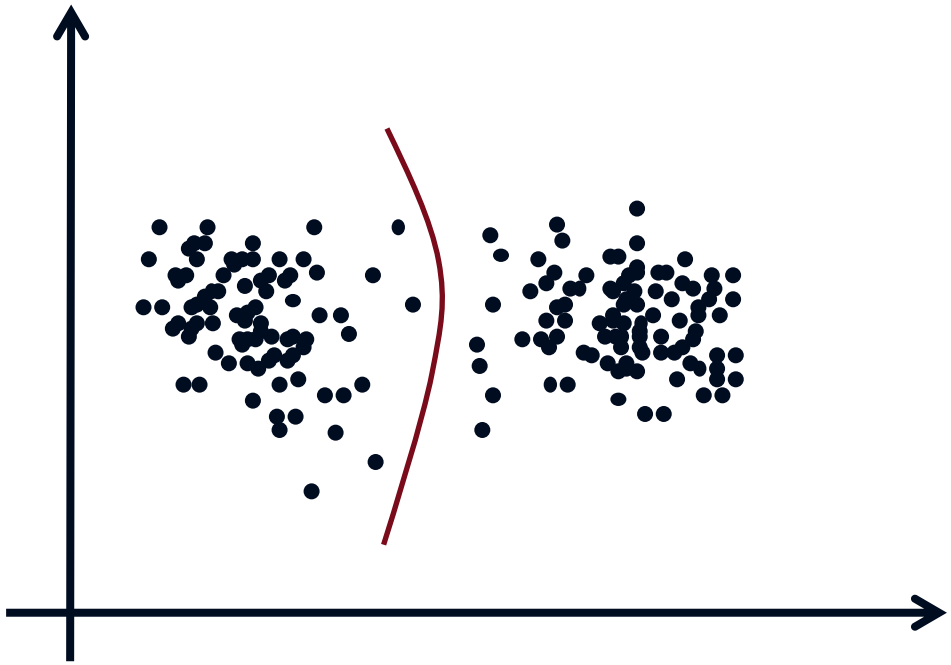
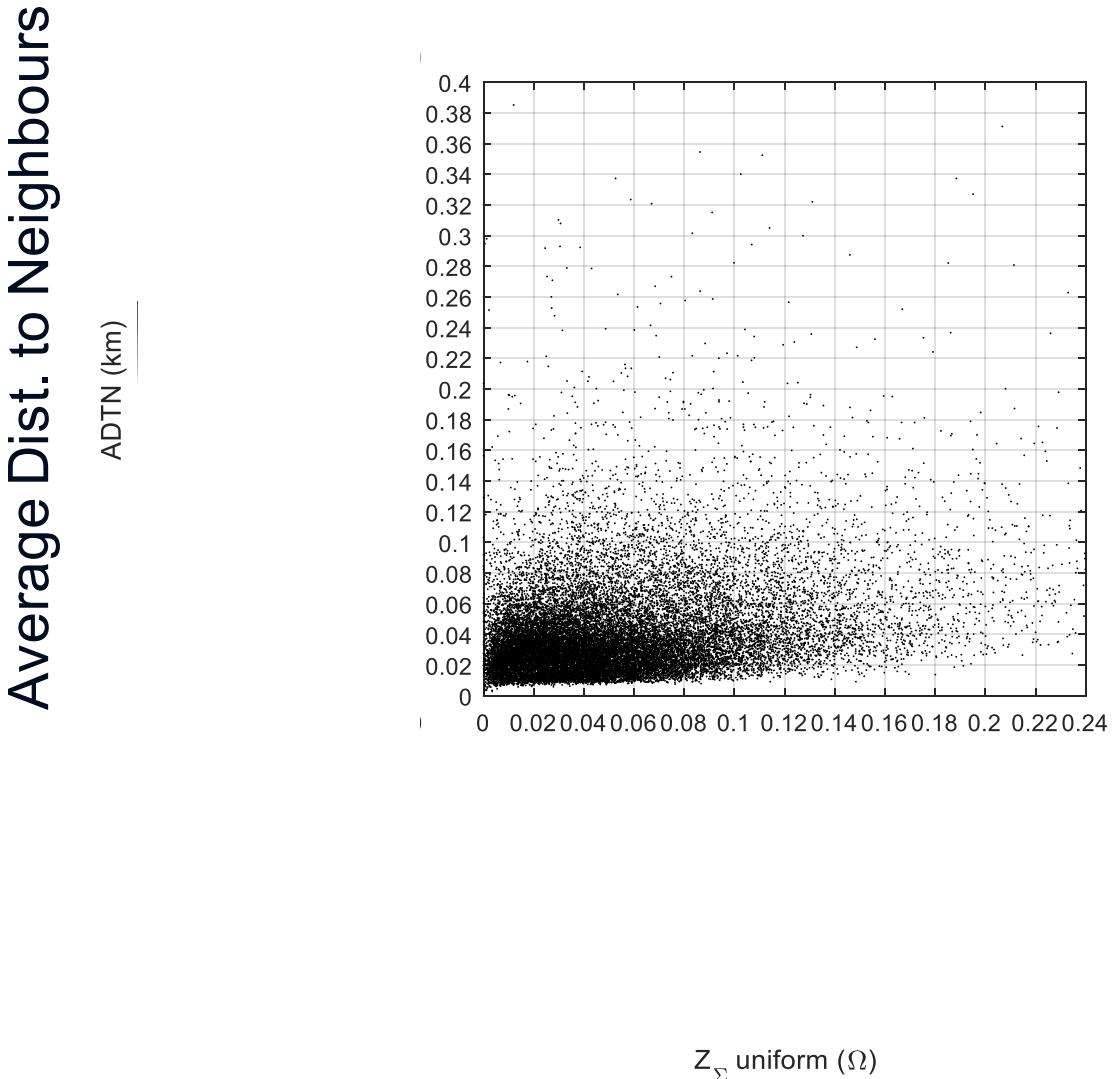
Supervised machine learning principle

- Unsupervised vs. Supervised learning
  (e.g. discriminant analysis, support vector machines, classification trees…)

- Parameters used:
  - Equivalent sum impedance
  - ADTN
  - Feeder length
  - Impedance at end node
  - Line length per connection
  - Average line nominal current



Classification attempt



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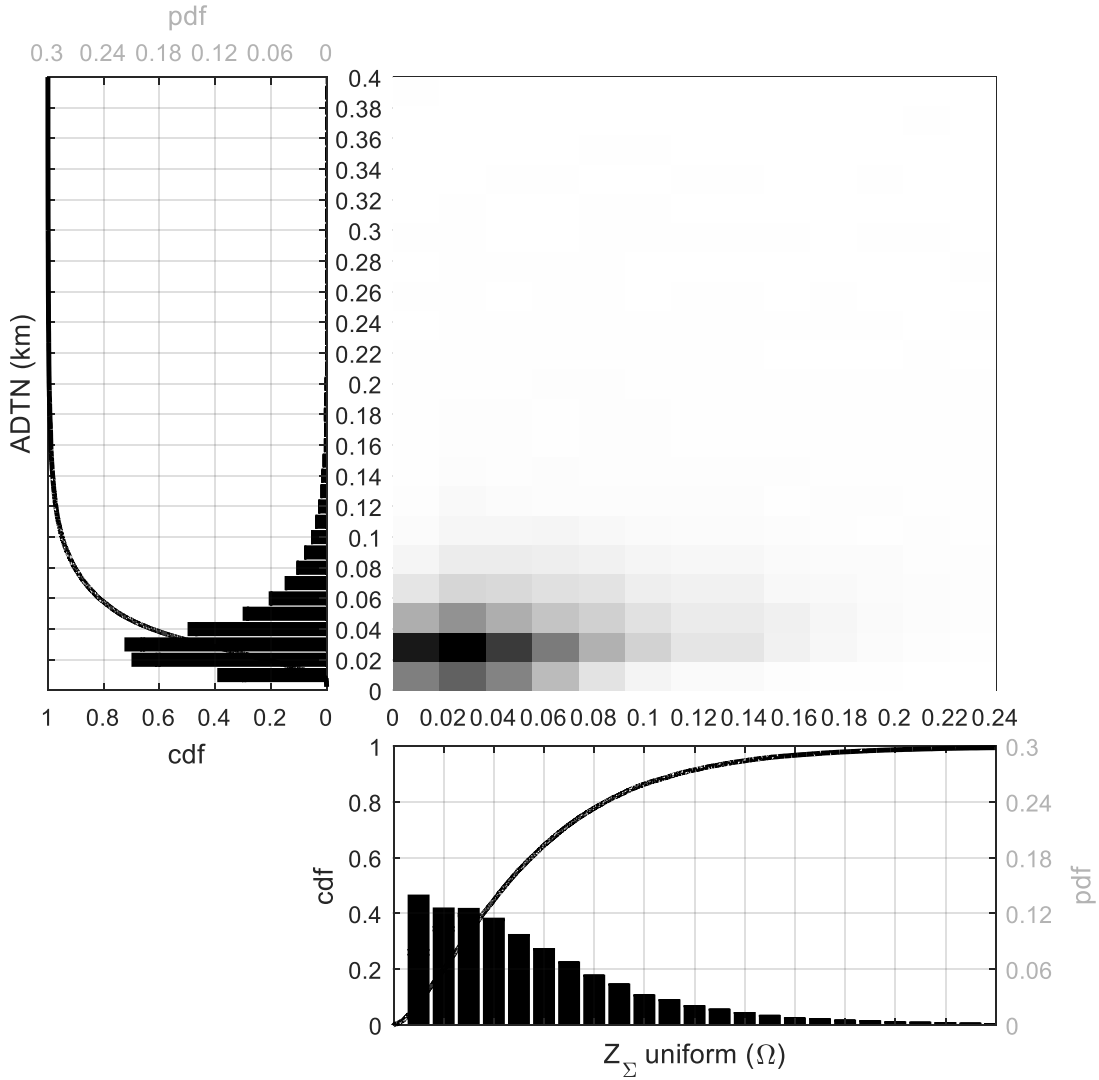

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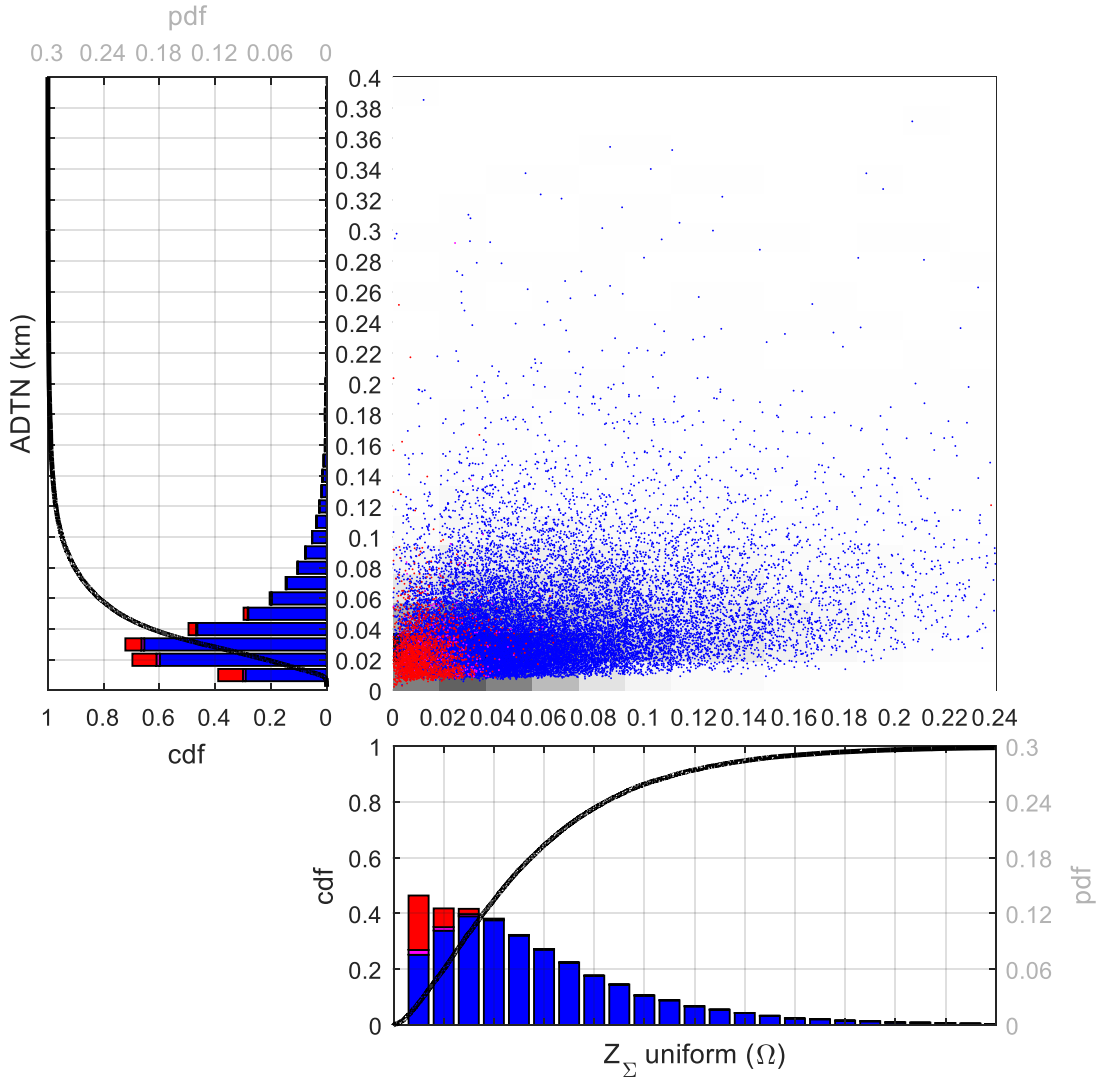

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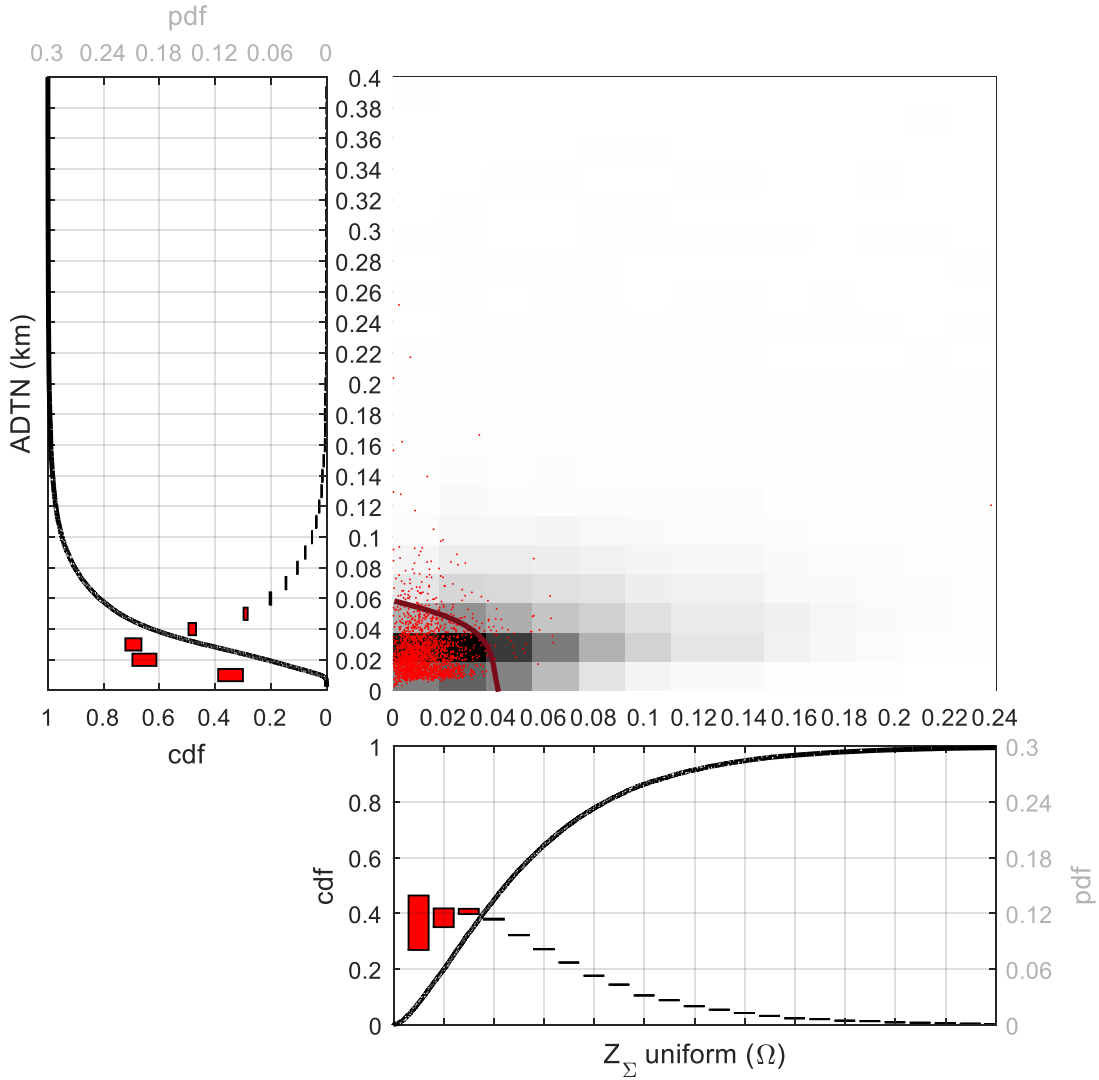

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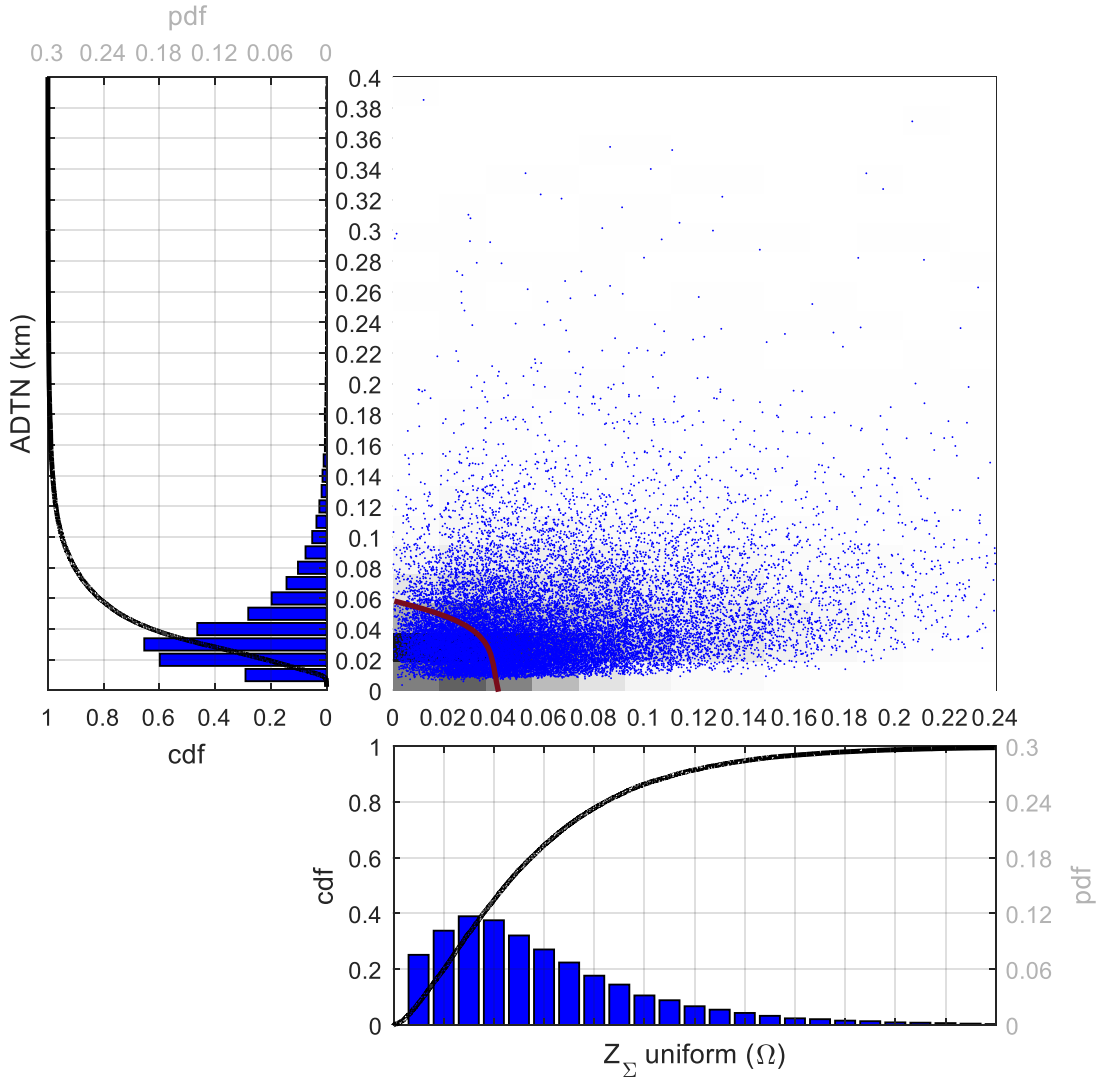

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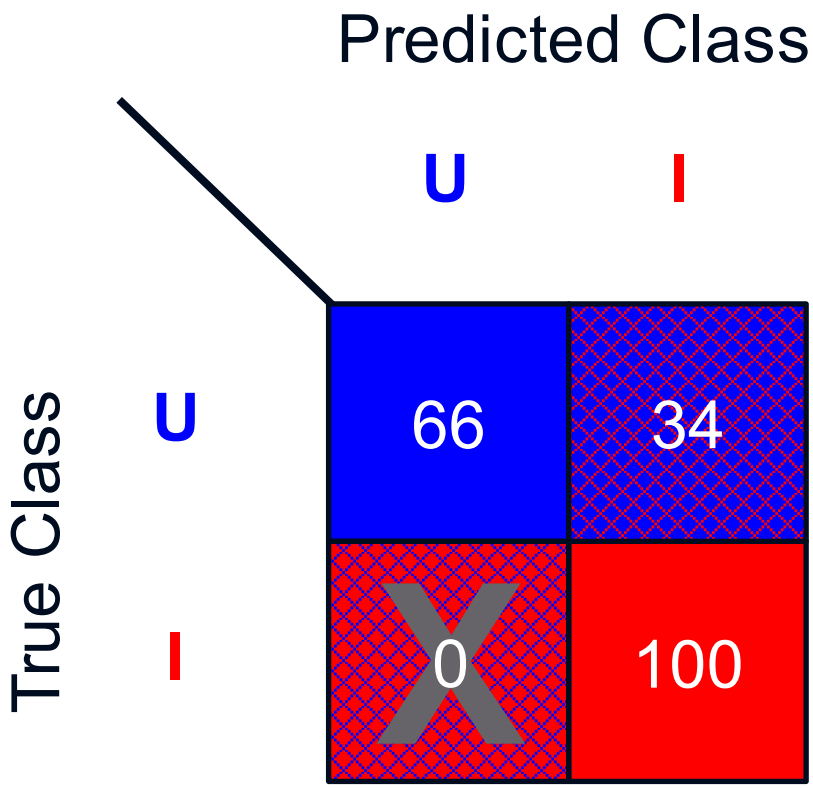
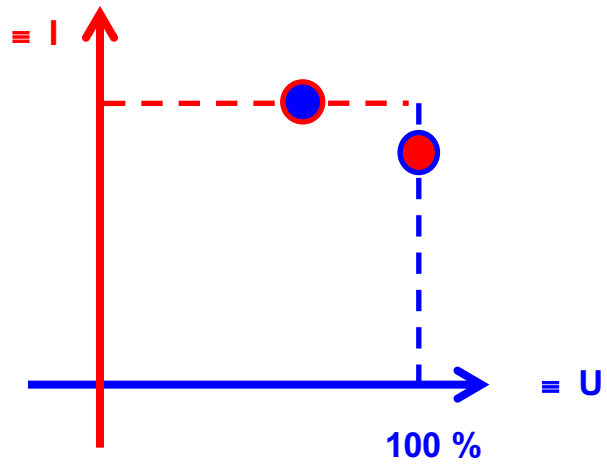
Performance evaluation (confusion matrix): need to adjust the misclassification costs





Conclusions

- Quantitative deployment potential of DVCT and Q(U)/cosφ(P) for 37.000 LV feeders:
  - Where (which feeders)?
  - How much (benefit)?

- Feeder classification (voltage/loading-constrained) is possible…
  …with however some limitations

- Outlook: report on the deployment potential of smart grids solutions in Europe (45 networks from 8 DSOs)

- More from IGREENGrid:
  - *www.igreengrid-fp7.eu*
  - *IGREENGrid final event*: 31 March 2016 (Madrid)
  - IGREENGrid @ *Smart Grids Week* 9-13 May 2016 (Linz)

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Thanks for your attention

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