A C2 Takeaway from the 2023 Cairns International Symposium

Ronan Jamieson

C2 – Power Systems and Operations

14/11/2023

Certified B Corporation

Baringa is a certified B Corp™ with high standards of social and environmental performance, transparency and accountability.

Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa Confidential

AGENDA

1	Introduction
2	Overview of the conference from a C2 perspective
3	Interesting papers - presentations
4	Q & A

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

About Baringa's Energy & Resources Capabilities

Collaboration in our DNA, which is why our clients rate us the top management consultancy in the sector

1800+ Employees

15 Offices worldwide

We help our clients structure and run more effective businesses

We work with clients to launch new businesses and reach new markets

We help our clients navigate industry shifts by bringing clarity and insight

300+ Energy Clients

#1 Energy and environment consultancy

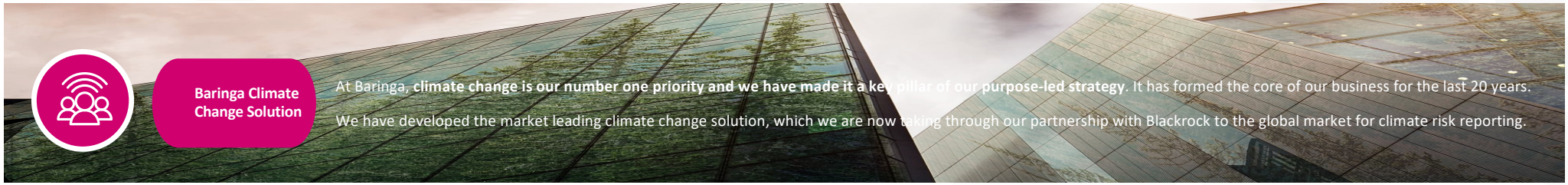
FT FINANCIAL TIMES statista — UK'S LEADING MANAGEMENT CONSULTANTS 2018 – 23

- Gold: Energy, Utilities & Environment
- Gold: Oil & Gas

- We currently employ over 500 consultants who specialise in the energy sector.
- We are recognised as the top ranked consultancy in the Energy and Utilities sector in the recent Financial Times survey of clients and peers, for the fifth year in a row.

We work across the energy value chain, providing our clients with both breadth and depth, combining deep sector expertise with our leading-edge capabilities

- **Generation & Investment**
- **Transmission & Distribution**
- **Smart assets & infrastructure**
- **Supply & Retail**
- **Customers**



Baringa Climate Change Solution

At Baringa, **climate change is our number one priority and we have made it a key pillar of our purpose-led strategy**. It has formed the core of our business for the last 20 years.

We have developed the market leading climate change solution, which we are now taking through our partnership with Blackrock to the global market for climate risk reporting.

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cairns 2023 Symposium – September 4th to 7th

"The End-to-End electricity system: transition, development, operation and integration"

Hosted by the **Australian National Committee of CIGRE**

The End to End Electricity System

Transition, Development and Integration

Participating Study Committees:

- **B1** – Insulated Cables
- **B3** – Substations and electrical installations
- **B5** – Protection and automation
- **C1** – Power system development and economics
- **C2** – Power system operation and control
- **C4** – Power system technical performance
- **C5** – Electricity markets and regulation
- **C6** – Active distribution systems and distributed energy resources
- **D1** – Materials and emerging test techniques
- **D2** – Information systems and telecommunication

The Symposium will also include specific sessions to encompass the biennial Conference on Integration of Distributed Energy Resources (CIDER) conducted by Australian Panel C6 and the South East Asia Protection Automation Conference (SEAPAC) conducted by Australian Panel B5.

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa Confidential

Keynote Speakers

Reflections

Was the largest attended conference outside Paris session with over **1300 delegates registered**!

Keynote speakers – **Adam Middleton** and **David Shankey**

- the magnitude of the journey to net zero (from a Queensland perspective)
- the need to do things different to achieve the net zero goals (the use of standardisation to simplify some of the supply chain challenges).

We **cannot** meet the global ambition of a net zero carbon energy system by 2035 by **doing what we have been doing to date** and we need to find **new approaches** to addressing the challenges of a low inertia system with a wide range of different source of energy at different voltages with the **whole energy system**.

The **central theme** running through both the papers and the presentations were

- **novel approaches** and techniques need to **be considered, tested and if successful then rolled out**.
- The **challenges that low inertia** and growth of renewable generation can **be assisted** by using **modern computing techniques (parallel and high performance**) to break the problem space **to manageable regions**.
- **New techniques** to highlight areas of **low system strength** need to be **adopte**d **and automatic load management** schemes **installed to assist** in controlling these regions.

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cairns 2023

C2 – System Operation and Control

This session had 2 preferential subjects

- **Learning from experiences**. What can we draw from past experience to develop the end-to-end electricity system?
- **Developing practices, functionalities and applications**. What are the current developments and their application for an end-to-end electricity system

Two Tutorial session were also run on

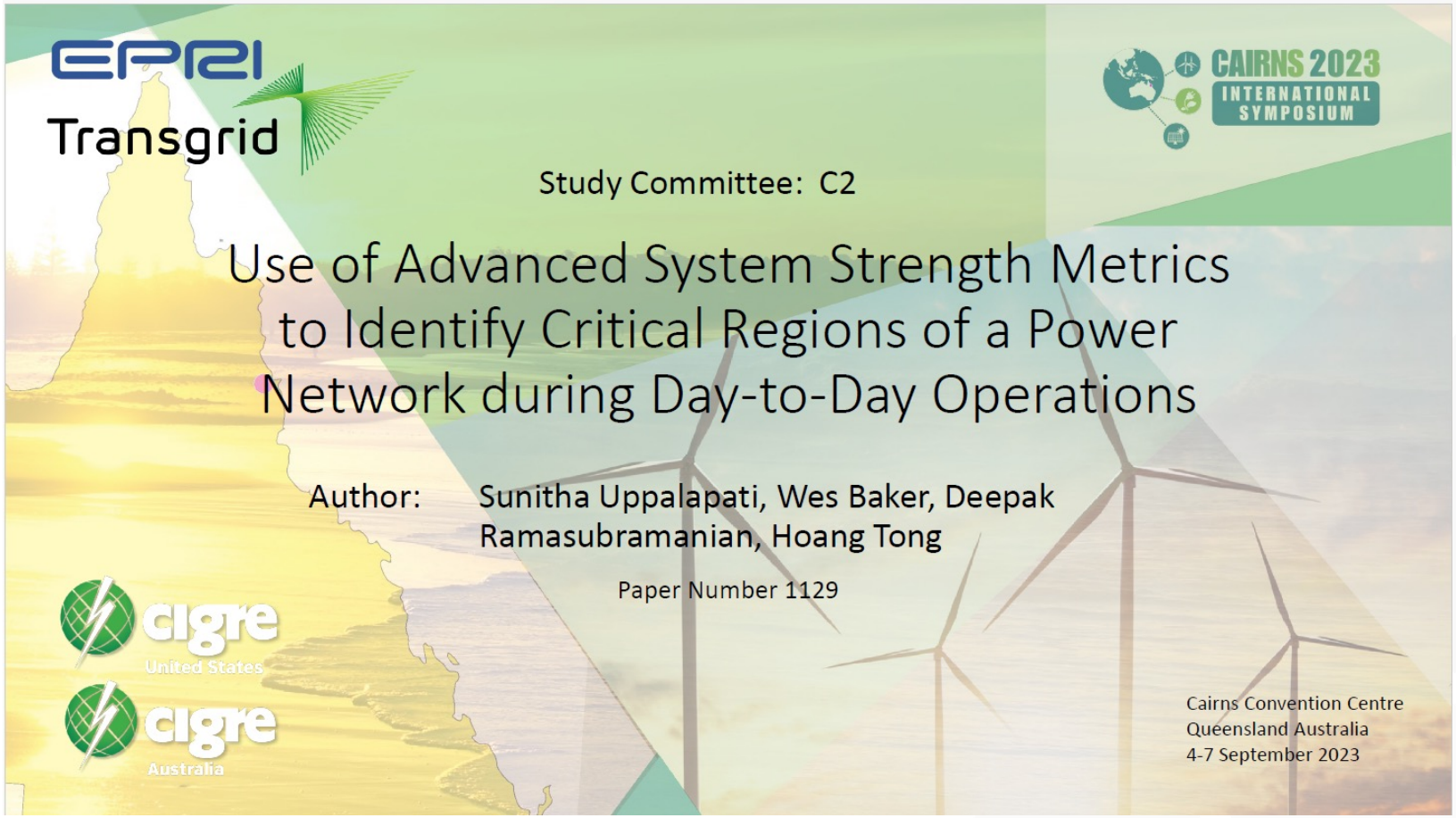
- **Franco Crisci** and members of WG C2.24 presented the tutorial titled "**Mitigating the risk of fire starts and the consequences of fires near overhead lines for system operations**" – associated Technical Brochure 868
- **Babak Badrzadeh** and members of WG C2.26 presented the tutorial titled "**Power system restoration accounting for a rapidly changing power system and generation mix**" – associated Technical Brochure 911

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1129

Australian contribution



 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

System Strength Metrics

- Based on an EPRI Tool called the Grid Strength Assessment Tool (GSAT) which calculates various system strength metrics from only a steady state analysis of the network model.
- It computes a conventional steady state generic short circuit ratios (SCR), including weighted and composite SCR,
- a new advanced short circuit strength (SCS) metric was proposed for evaluating the potential for inverter controller instability. The advanced SCS metric is referred to as critical clearing time (CCT).
- GSAT can also determine these metrics during outage scenarios thereby providing a system planner with a comprehensive overview of day-to-day changes in system strength.

Weak grid indicators	Vulnerable or high-risk generators
a. POI buses with SCR < 3.0. This metric indicates weak system locations.	a. Generators with CCT < 0.12 seconds. This metric indicates high-risk of instability generators.
b. POI buses with a SCR change > 4.0 from one contingency to next at any time of operations. This metric indicates the evolution of system strength as transmission network topology changes.	b. Generators with a CCT change > 0.2 seconds from one contingency to next at any time of operations. This metric indicates the evolution of generator instability tripping conditions as transmission network topology changes.

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

System Strength Metrics - Results

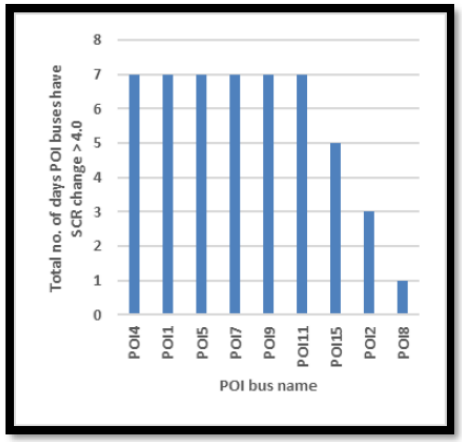


Figure 2a POI buses with notable change in SCR

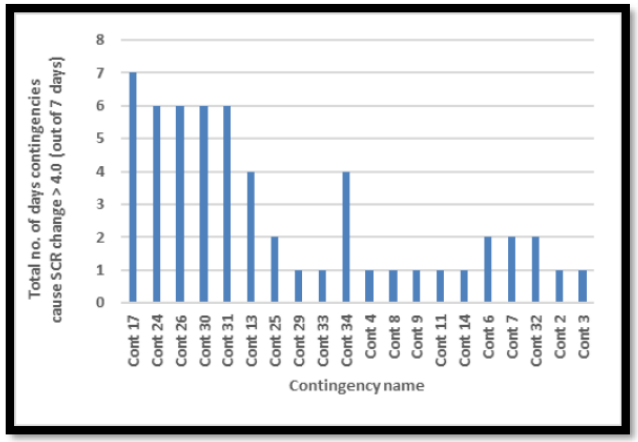


Figure 2b Contingencies causing notable change in SCR

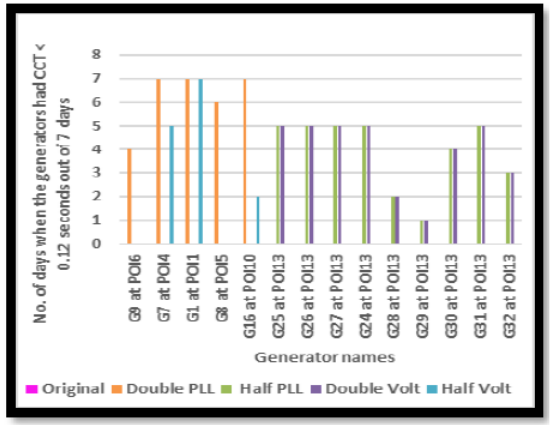


Figure 3a Generators with low CCT

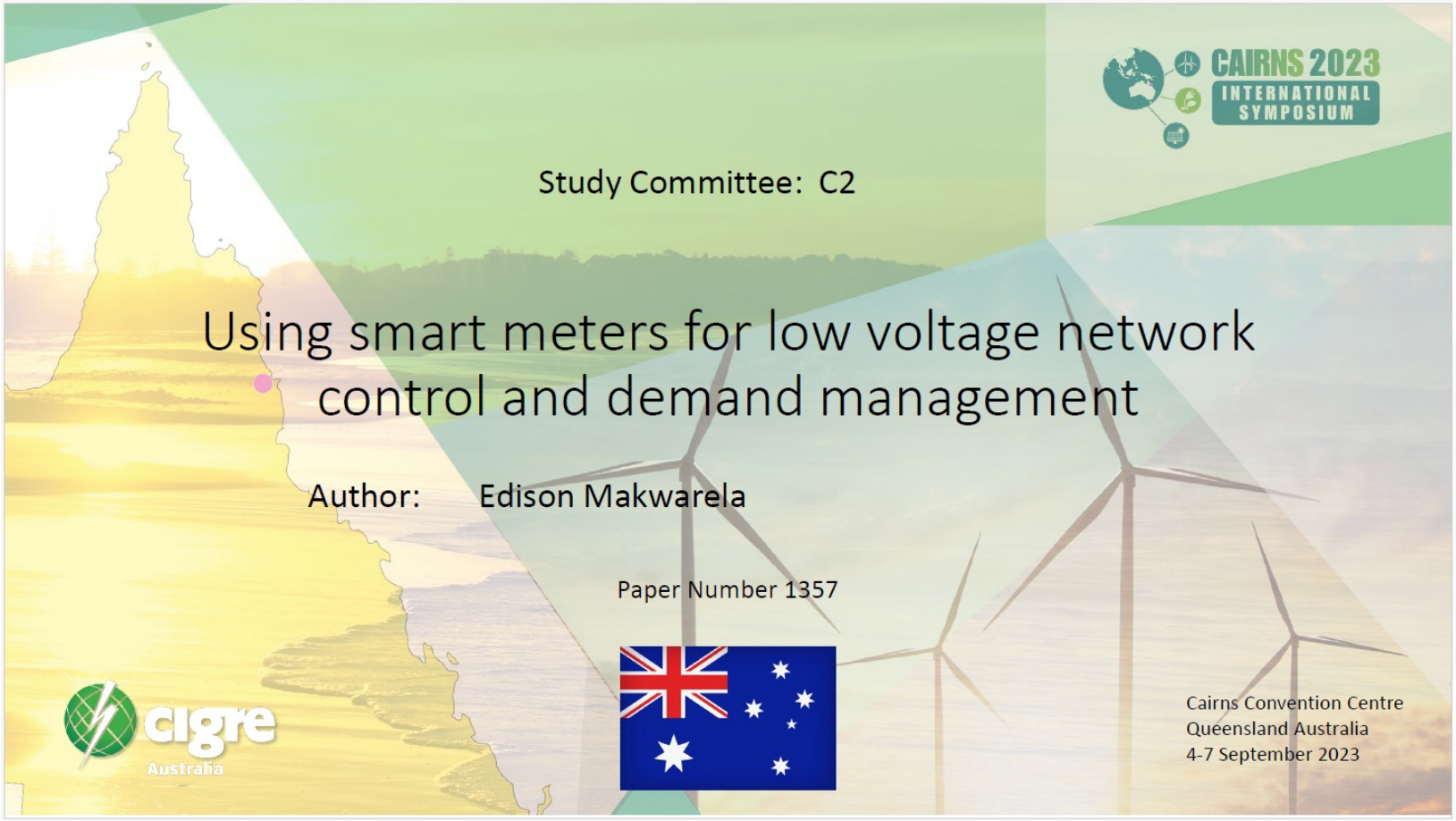
Figure 3b Contingencies causing low generator CCT

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1357

South African contribution



 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1129

Support **Demand Management** through:

•Load Shifting -Shift load of medium to high (1000kWh/month) residential consumers (LSM7 and above) through TOU tariff

•Promoting Customer Behavior Change -Incentivize the efficient use of electricity, power conservation through dynamic tariffs.

•Load Control –Control non-essential appliance load during system constraints / emergencies –About 3500 MW (7000MW nationally)

On demand controls

• Remote connection/disconnection

• Selective disconnections leaving essential loads on

e.g. houses with special needs, schools, hospitals,

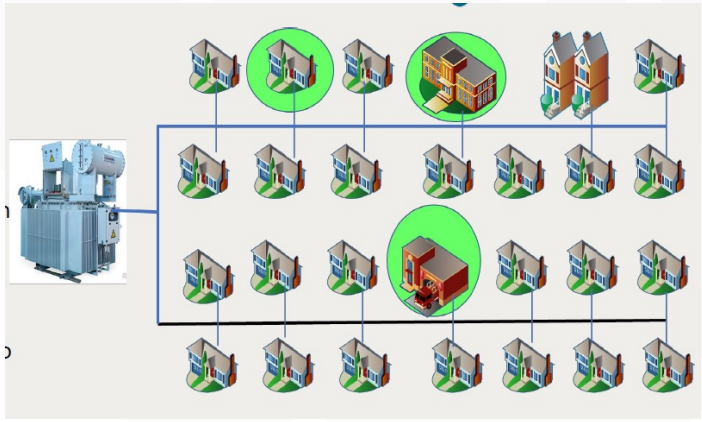
• Temporary take off some load off the network when

the system is under constrain

• Render meter not useful by setting load limit to zero

• Limit energy exported to network by customer

• Remote configurations



 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1129

Auto controls

• Automatic disconnection when under/over voltage is detected, meter auto reconnection when voltage is normal

• Automatic disconnection when overload is detected and auto reconnection. E.g. NMD exceeded

• Staggered power come back to eliminate surges.

• Auto disconnect on power failure

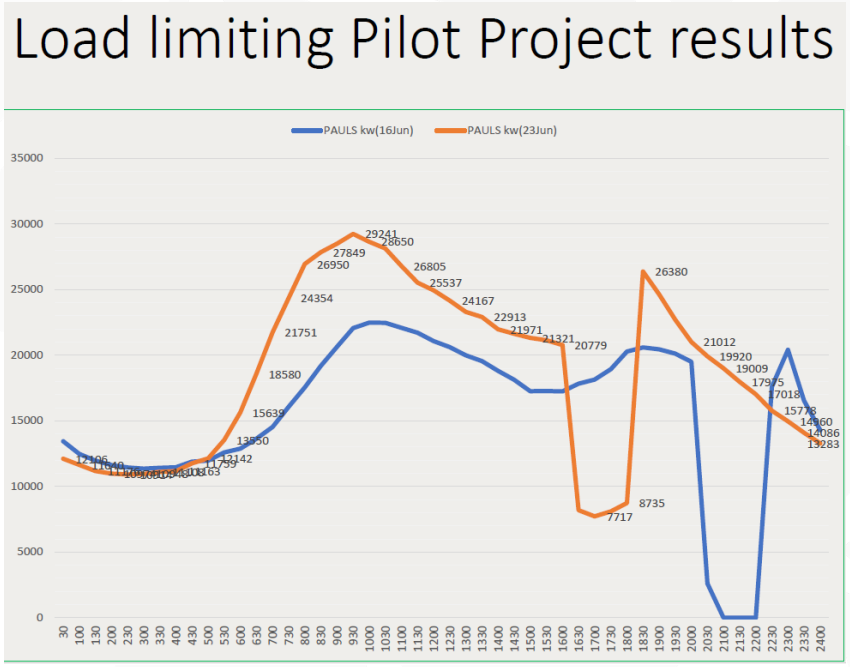
Customer cannot export energy to network

Utility staff safe if working on network

- If set power limit is exceeded, meter disconnects supply and
- locks out for a period

•**Activation**: Load limiting schedule/command is sent to the meter and is set to expire at end of a pre-determined period.

•The meter automatically resets back to its original state at the end of the defined period.

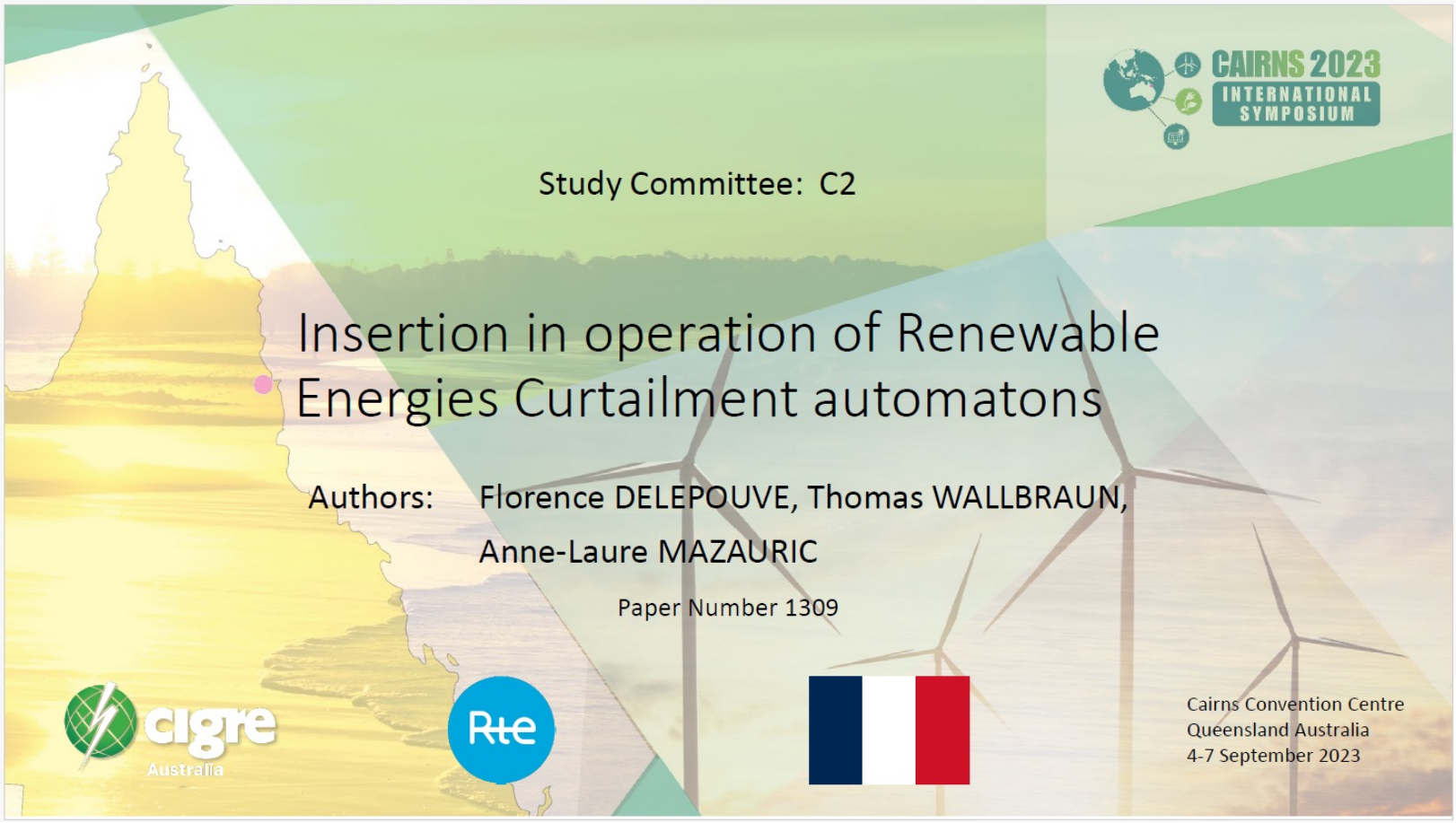


 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1309

French contribution



 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1309

Optimal grid dimensioning

RTE industrial choice to manage grid constraints & curtailments

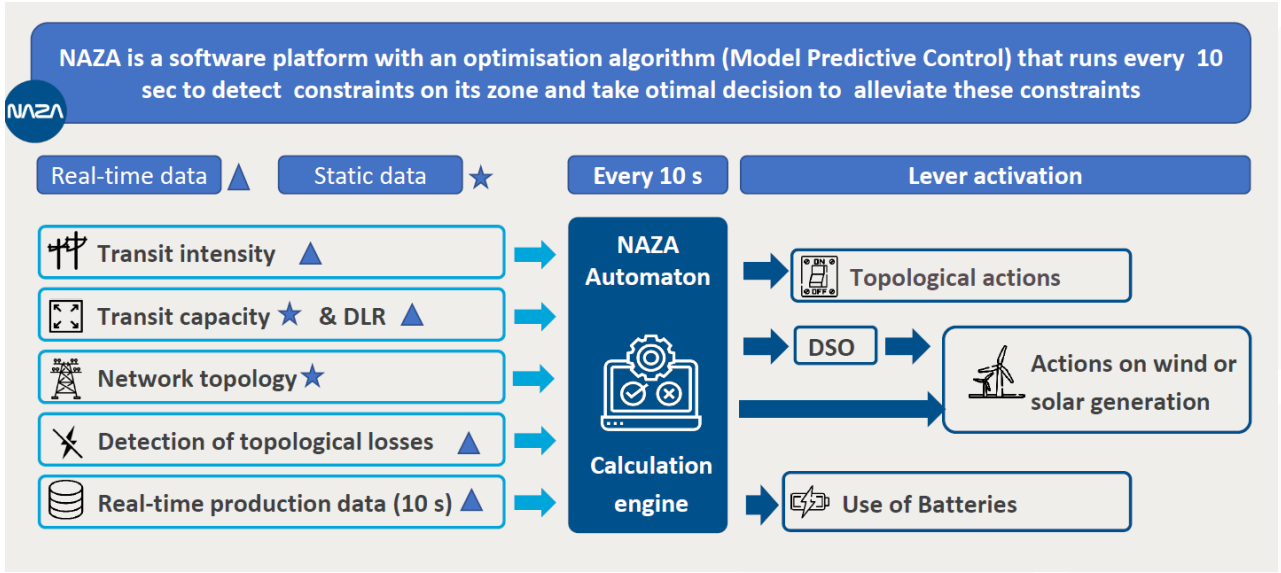
- 95 % of wind and solar production is connected to the Distribution grid
- Real congestions can only be forecasted close to real -time
- Curtailments must be acceptable for producers

RTE has designed and is deploying an **automate based solution** with real time grid constraint detection to minimize curtailments

NAZA — Nouvel Automate de Zone Adaptatif

- Connected with producers (via DSO for those connected to the distribution grid)
- Interfaced with Back-office systems for financial compensation of producers

NAZA Technical solution

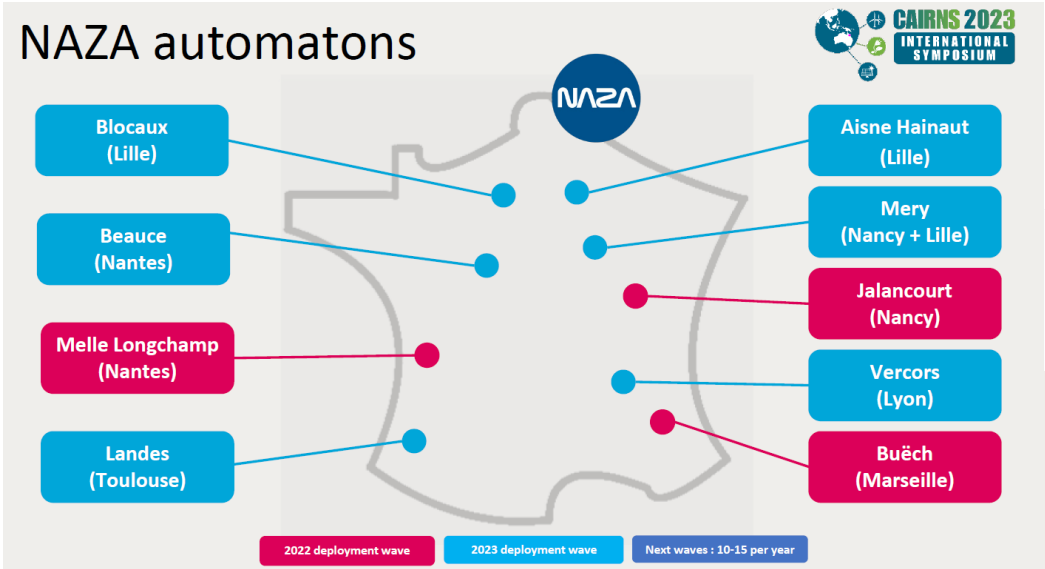


 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

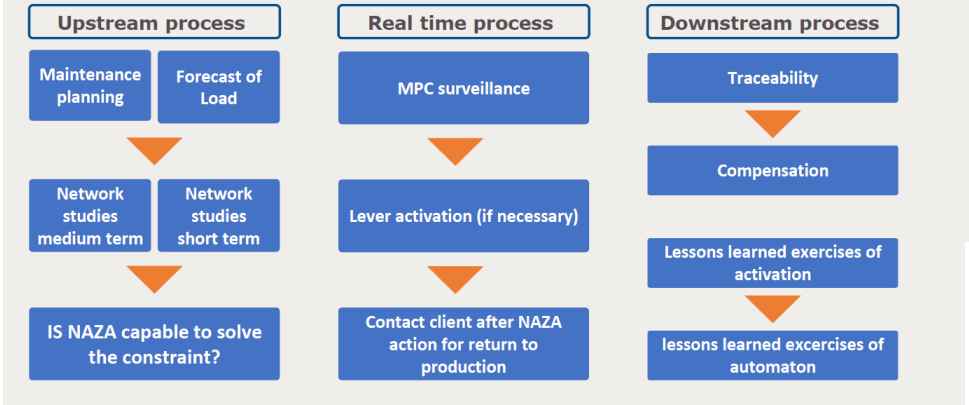
Baringa

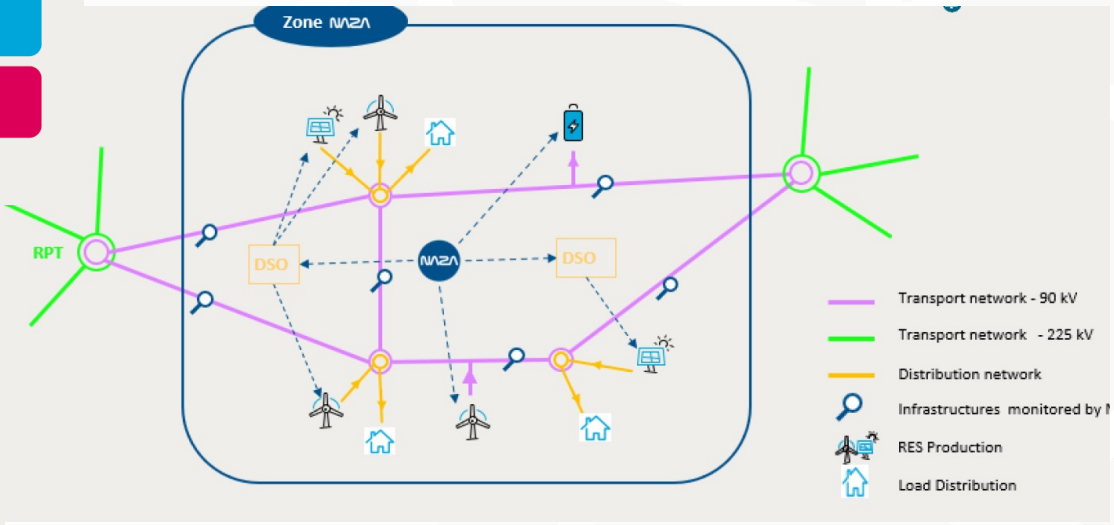
Cigre Cairns C2 - Paper 1309

NAZA automatons



NAZA Business processes





 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

Cigre Cairns C2 - Paper 1426

Vietnamese contribution

 Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa

This document: (a) is proprietary to Baringa Partners LLP (“Baringa”) and should not be re-used for commercial purposes without Baringa's consent; (b) shall not form part of any contract nor constitute acceptance or an offer capable of acceptance; (c) excludes all conditions and warranties whether express or implied by statute, law or otherwise; (d) places no responsibility or liability on Baringa or its group companies for any inaccuracy, incompleteness or error herein; and (e) the reliance upon its' content shall be at user's own risk and responsibility. If any of these terms is invalid or unenforceable, the continuation in full force and effect of the remainder will not be prejudiced. Copyright © Baringa Partners LLP 2023. All rights reserved.

Copyright © Baringa Partners LLP 2023. All rights reserved. This document is subject to contract and contains confidential and proprietary information.

Baringa Confidential