“The Green Deal, Power in Motion: Design advancement from a transactive energy system to a fully permissionless financial & predictive - system for green energy “

Part 1: integrating crypto anchoring for capitalization & trading of green energy.

Rik Verheyen – Business Development Mgr. Bausch Datacom
15 September 2022.
All companies mentioned are without any specific further obligation or commitment and are used only by the author to demonstrate their interest and involvement in the cutting edge technologies and business models mentioned in this paper.

1. Stakeholding companies & associations

- Bausch Datacom
- Sunified
- RiTTec
- 2Tokens
- Riddle & Code
- eNovates
- IBM
- Ritter Starkstromtechnik
- EnergyVille (University of Leuven)
- IMEC (University of Ghent)

2. Short summary of the aim of the partners

Bausch Datacom, Sunified, 2Tokens and RiTTec have bundled their forces to develop in stages – external to DSO operation - a 'predictive and fully permissionless energy service – :

- Part 1: to facilitate a system of capitalization and trading of green energy for private persons and entities using tokenization (crypto anchoring Fintech) and Machine learning technology.
- Part 2: procure forecasting and real time state grid estimation services to DSO's based on decentralized Green Energy production and storage data using tokenization, Artificial Intelligence and Machine learning technology. (This second integration of services will not be part of the first phase of the technology.)

3. Description of the Green Deal technology

3.1 Context:

3.1.0 The Green Deal

The Green Planet as we call Earth is not so green any more. A fast iteration towards more green technologies is needed, discussed and ongoing. The challenge to combine economic and ecological demands is however not evident. Price or Planet?
The solution for this dilemma could and probably will be as always practical orientated. The more technologies that facilitate energy trading and property are around, the more people will use solar, EV, wind and others as an income to overcome exponential fossil energy prices.
Whereas in the 1920's the US saved a complete continent from poverty, it could well be that in the 2020's private entrepeneur ship will save the day.

3.1.1 Diversity of relations between electricity stakeholders – New opportunities

The liberalization of the energy market is initiating a process of more and more private ownership and trading of green energy (electricity). 'Self governance for energy communities' is a notion that through nobel price winner Elinor Ostrom is becoming more and more a real concept and in fact is waiting only for the right technology to completely break through.
Therefore, the digitalization of the energy market to facilitate and the emerging new trade possibilities of (green) energy and control of the MV/LV distribution of electricity into a well-functioning entity is, as we speak, a new step in the information revolution that already started in the early nineties of the 20th century. An 'Internet of Energy' will fully emerge in the third decade of the 21st century.
The harmonizing of the new opportunities – forecasting, capitalization and trading of green energy, digital payments with crypto energy assets - with the challenge of keeping the traditional electricity grid in balance (50 Hz) - and supplied with green energy - by knowing the true system state, having the ability to isolate problem areas, adapt the system operation, diagnosing and anticipating the problems

remotely - is one of the biggest challenges of our era.
It is clear we will be seeing a decade of initiatives that eventually will result in a few guiding systems such as we already know from former Internet pioneers and market leaders such as Microsoft, Apple, Google, … and the modern financial and banking Internet systems (ATOS Worldline…) we know nowadays. An 'Internet of Energy' integrated in web 3, will be the only solution to counter the complexity of the exploding (Green) Energy market and concurrent grid balance problems. A 'fully permissionless predictive system for green energy' will be the necessary step to the new era of energy trading and control.

3.1.2 Diversity of relations between electricity stakeholders – Incapacity of DSO controlling.

This liberalization of energy production and wide-scale adoption of distributed generation - electric vehicles, solar panels, heat pumps - have brought with them a host of opportunities but also challenges to all the (new) stakeholders in the exploding energy (world) market. The transition towards a more green and sustainable energy production and a further electrification comes with major investments in the distribution grid. The bi-directional and variable energy flows and the increasing electricity demand urge for a dramatic increase in closer monitoring, control and analysis of the energy flows in general. The exploding amount and diversity of relations between energy stakeholders in the evolving energy market based on Solar, EV, heath pump coupling and other green energies result in the simple fact that DSO SCADA monitoring will not be sufficient any more to control the electricity grids in the near future.
All the above demands a paradigm change in the way of monitoring and controlling the different energy (electricity) flows in the near future. This can only be done using a predictive and fully permissionless energy service – external to DSO operation:

- Co-existence of SCADA grid monitoring and external (permissionless) systems
- Evolution of a static (grid) monitoring of energy flows towards a flexible one.
- Migrate from a 'No overview of state of grid' – 'Fit and forget approach' – to an increase of network state observability – 'Forecast and remediate'
- Deviate from 'fixed rule-of-thumbs' and none or little operations based on actual observations towards organizing a multi-objective Demand Response control based on grid observations across the Cloud/Edge ecosystem in a scalable manner

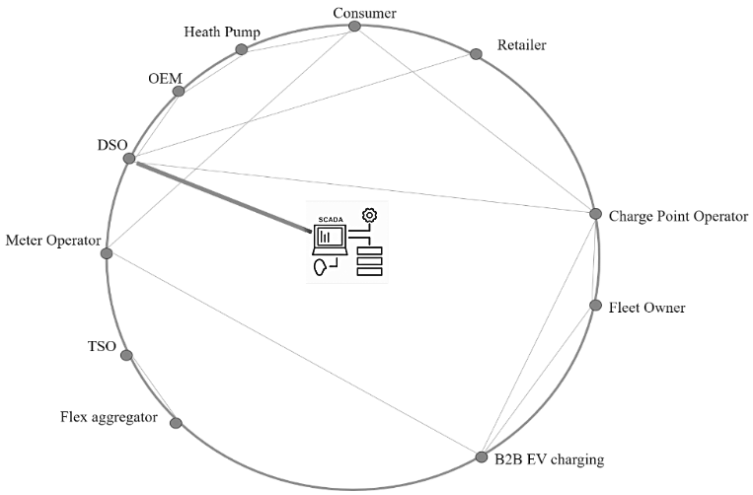

Fig. 1: Overview of the diversity of relations between energy stakeholders resulting in new opportunities but also DSO SCADA monitoring issues (Fig. IBM)

3.2 What is a 'fully permissionless predictive system for (green) energy'

A 'fully permissionless predictive system for (green) energy' is a system of capitalization and trading for private persons and entities based on green energy coming from Solar Parks, EV infrastructure, battery loads etc. taking in account the influence on the electricity grids. The important factor however is that it exists next to DSO systems and does not need to be necessarily integrated in it. Eventually DSO and new systems will 'grow together' into one system complementing each other but eliminating double functions. This evolution will take however considerable time. A fully permissionless predictive system for monitoring and trading green energy should emerge in the near future next to SCADA and other more traditional existing systems. Obviously this is an evolution in phases.

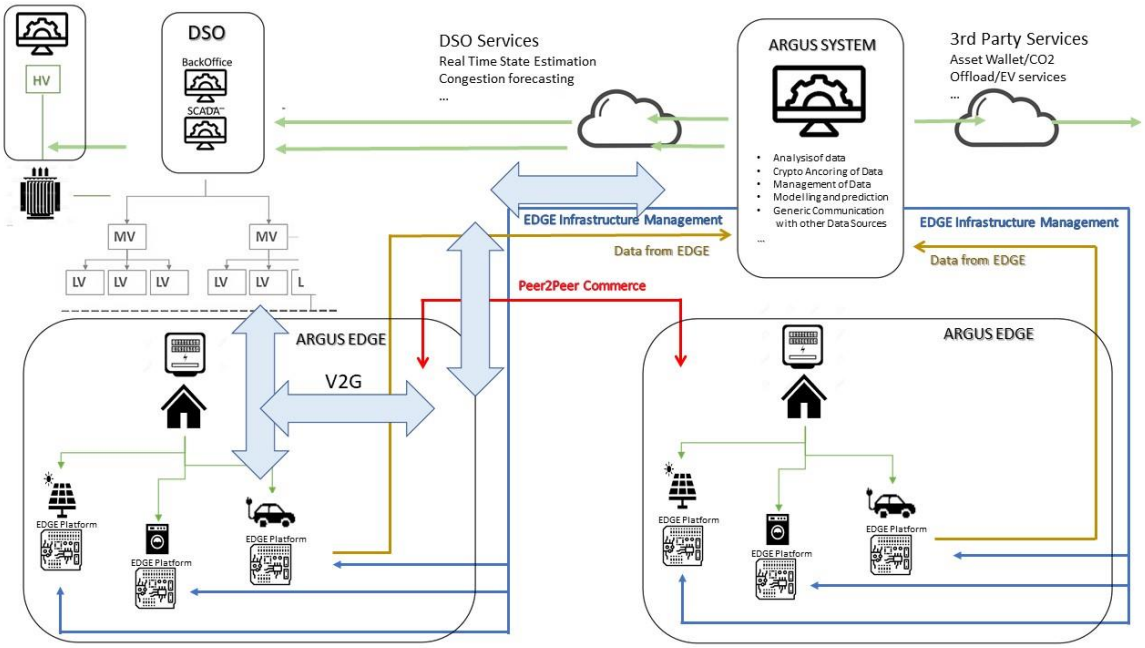

Fig. 2: fully permissionless predictive system for green energy

3.3 What is the system about – which technologies are used?

Under the impetus of 2Tokens, IBM, Siemens, Shell and many other major players out of the industrial, financial (tokenization) and IT technology world, companies such as Sunified, RiTTec, Bausch Datacom have recently bundled their forces to develop technology that can facilitate such a system. They are in their turn linked to many interest groups and academic instances such as 2Tokens, EnergyVille (KULeuven), IMEC (University of Ghent), University of Krakow…

Crucial in the system is importing blockchain and crypto anchoring – technologies coming from the financial market (Fintech) – and techniques such as Machine Learning, Artificial Intelligence and Open-Source protocolling. By introducing these technologies, a system of ownership and trading of green energy can be built and distributed in a global market together with the possibility to offer services to DSO's concerning the impact of this new evolution. Eventually major players such as Siemens, IBM, ABB and others will be integrating the best of the best pilot smart back-offices/EDGEplatforms technology in their systems while for instance companies Sunified and eNovates could offer smart 'Next Gen' EV and Solar infrastructures to companies such as Shell (already a customer of eNovates) IBM and European municipalities/regions.

The Sunified group has developed a patented 'Unity Chip' which is the core of the system. It 'tokens' the data, giving it an authentification stamp so the data cannot be reused for other energy streams, e.g hacking the data is useless! This is a technique that is used in many fintech and other applications and

also for crypto currencies and is a hot item for many development instances. Also the patented Unity chip of Sunified will follow in the next years an R&D roadmap incorporating Quantum Computing techniques
To be effective this Unity Chip cannot operate on its own but needs to be integrated in all kinds of infrastructures. This hardware integration in all kinds of electronics will be done by the Belgian company Bausch Datacom. Bausch Datacom wil in fact build the hardware platform. The necessary software to manage and run the applications will be done by RiTTec (member of the Ritter group as is Bausch Datacom), "and other SW partners.
The application, which is foreseen, is to offer a complete tokenized flow of energy data that is collected by a remote system which can analyze it and send it to 3rd parties where it can be consulted.
The technology will be in first instance used to authenticate the energy coming from Solar Parks and EV infrastructures (Vehicle2Grid). (Many more applications can be foreseen of course). This will allow the usage of specific apps to manage the incoming data and use the data for verified analysis which is useful for the state of the grid.

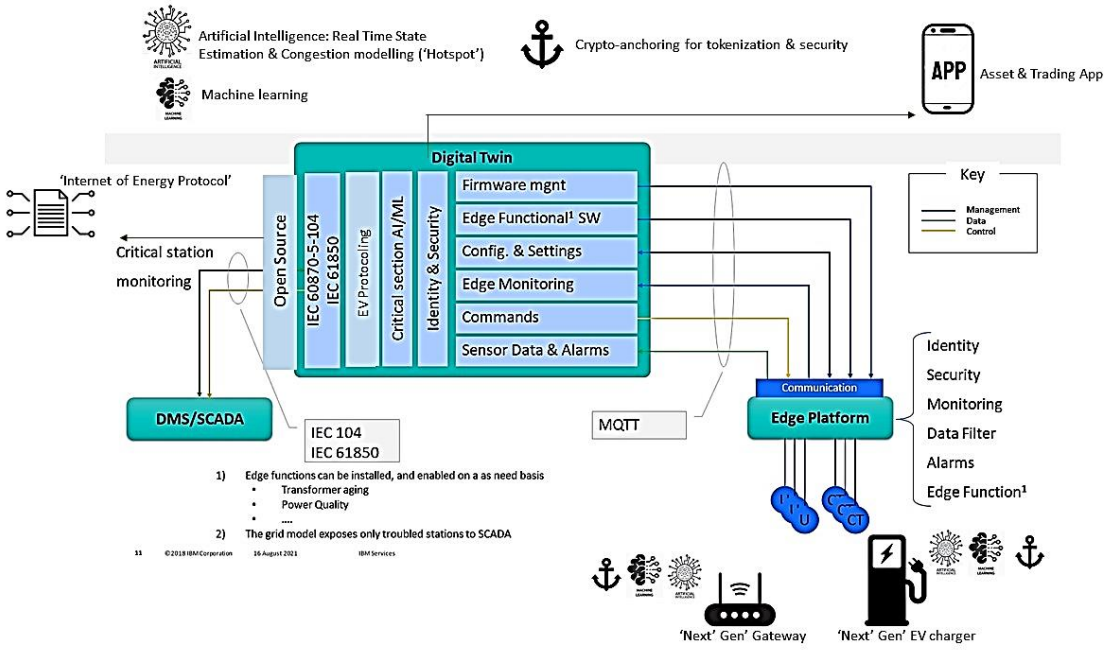

Fig. 3: Overview topology and techniques of a fully permissionless predictive system for green energy (figure IBM)

3.4 Existing basic technology

The crucial factor of 'time-to- market' is solved by the already existing basic EDGE platform technology - The Bausch Datacom RTU Q7 hardware https://www.bausch.eu/products/rtu/dinbox-rtu-q7 - and the Device Management System - The RiTTec DeMaS: https://www.bausch.eu/products/rtu/demas-management-tool. This technology is conceived from a long life, security and cost effectiveness perspective. The complete System will now be enhanced by Machine Learning, AI and crypto anchoring techniques.

3.5 An Internet of Energy protocol

A next huge step in the evolution of IT will be the growth towards an 'Internet of Energy'. This will be the platform where fully permissionless predictive systems for green energy will meet. An 'Internet of

Energy' protocol will be preferably Open Source, not privately owned. For instance protocols such as Horizon (tough IBM orientated) could be used.

3.6 Aim of step 1 of the technology

In this first step the consortium will focus only on the establishment of a topology of remote EDGE platforms (hardware gateways) with the possibility to crypto-anchor the data it sends to a central management system. This phase 1 will be executed by Bausch Datacom, RiTTec and Sunified. The results of the &D will be continually shared and monitored together with specialist organisations such as 2Tokens and others.
This is a first step in tokenizing the data coming from EV or Solar (or other) infrastructures. In a second step the Solar or EV infrastructures itself will crypto anchor the data they send. The analysis and conceptualization of this topology is crucial because it needs to allow a later integration of the follow up applications and setup a system that can be generic and eventually worldwide used.
The tokenized data coming from the EDGE platforms will be collected by a central management system that can send it to the users of the data. We will focus on 3rd parties that use the data for energy capitalization and trading, they will in fact receive it on their smart phone in the dedicated 'Assets' app that is designed. A proto app will be therefor developped. (in later steps the data which is collected by the central system, can also be analyzed for Real Time State Estimation and forecasting energy capacity, congestion and others, services that can be offered to DSO's - without the need for the DSO to invest in its own infrastructure-) This will be a next step in the R&D.

3.7 Overview of the information to be collected and research in 2023

- Projects will furnish crucial information about the feasibility of a system of crypto anchoring and tokenization facilitating ownership and trading of green energy with regards to the relation between technology and business models (The analysis of the influence on the state of the electricity grids will be done in part 2 of the project and will involve additional technologies)
- Projects will produce a working model of a software central unit that manages the Gateways (EDGE platforms) & EV infrastructure in the field, analyzing the incoming data of this Gateways & EV infrastructure based on Machine Learning algorithms & crypto anchoring producing Asset Control for 3rd party stakeholders.
- The EDGE platforms will be beyond State-of-the-Art featuring machine learning and crypto anchoring. They will be finetuned to have long life (processor power to handle new IT evolutions and applications), designed from a security perspective and cost-effective (to facilitate mass usage).
- The model will be able to communicate with 3rd Party systems through Open- Source protocolling.
- Projects will propose basic SW for the apps that can be used for the ownership and trading of green energy.
- Pilots to demonstrate the technology will be tuned around an EV and/or Solar use case, being the first markets in scope for the participating parties. It will in fact investigate the feasibility of the used technologies. It will also produce useful information on which techniques to use.

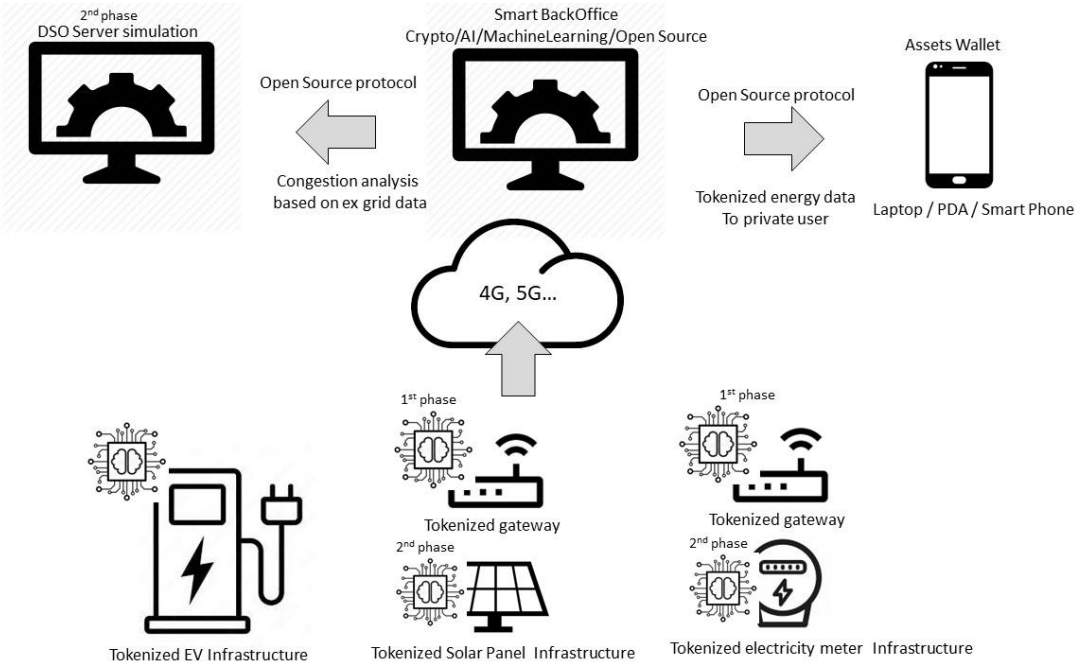

Fig. 4: Topology of the demo of the first phase of the project

Remark: The follow up of this project – Part 2 - will deal with Real Time State Estimation and Congestion Modelling analysis by the central management to be proposed as a service for the DSO's. This research and demonstration will not be part of this dossier.

3.8 Roadmap

- Q4 2023: first prototypes of a 'Next Gen Gateway' with crypto-anchoring technology integrated.
- Q4 2023: beta version of the DeMaS management system with crypto-anchoring technology integrated.
- Q1-2 2024: Industrial prototypes 'Next Gen Gateway'
- Q1-2 2024: Integration of Unity chip in Electricity Metering infrastructures.
- Q1-2 2024: Integration of Unity chip in EV charging infrastructures.
- Q1-2 2024: Integration of Unity chip in Solar Panel infrastructures.
- 2025: Integration of Artificial Intelligence in 'Next Gen Gateway' and DeMaS management system
    - Technology for a fully permissionless predictive system for green energy
    - Pilots for new business models based on a fully permissionless predictive system