Sistemas de Gestão e Troca de Energia

Articulação com a norma ISO 50001 e com as necessidades de balanceamento da rede

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Ordem dos Engenheiros
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Virtual Power Solutions (VPS) is an established provider of technology and services for utilities and energy consumers. Provides **ESaaS (Energy Savings as a Service)** to all sectors: industrial and commercial, SME and domestic and enables the creation of **Energy Communities** with VPP technology to deliver new added value connecting distributed energy resources.
History of pioneering and market leadership

SaaS becomes mainstream 10 years later

- Pioneering cloud based oil & gas metering solution (SaaS)

2000

Pioneering cloud based energy management solutions (Energy Savings as a Service – ESaaS)

1990

2010

ESaaS becomes mainstream in 2013

Pioneering Active Demand Management with energy community aggregation services

2014

Paving the way for market development

Pioneering Hybrid Virtual Power Plant enabling added value services with AI optimization and blockchain

2020

Supporting energy transition

Harnessing the potential of Energy Distributed Resources and Demand Response

2017

Kiplo® market deployment (new VPP user interface)

2012

Cloogy® launch (domestic EMS & ADR solution)

2015

ALISA Listed NYSE Alternext

ISA* Intelligent Sensing Anywhere

ISA Energy

VPS Virtual Power Solutions

Powering a pro-active future
Business References

Utilities
Monitoring more than 1000 points over all Hydro Power Plant generation in Portugal
Supporting more than 400 industry MV clients with energy management

Industry
More than 150 industries with energy flexibility management and energy efficiency (technology and energy service)

Banks
More than 700 bank branches with VPS’s technology and energy service

Hotels
More than 30 hotels with VPS’s technology and energy service

Airports
All international Portuguese airports with VPS technology (over 4000 measuring points)
Agenda

1. **Virtual Power Solutions presentation**
   - VPS background and key competences
   - Reference projects

2. **Transição energética – necessidade e oportunidade de mercado**
   - Renováveis e produção descentralizada
   - Eficiência energética, controlo da procura e balanceamento da rede
   - Digitalização das redes energéticas – a Internet da Energia
   - Micro-redes e Comunidades de Energia

3. **Articulação com a norma ISO 50001**

4. **Comunidades de Energia e novos desafios**
   - Comunidades de Energia locais e virtuais
   - Sistemas de troca de energia
   - Armazenamento de Energia
   - Big Data, Inteligência Artificial e Blockchain
Global opportunity: inefficiency in buildings

>1bn buildings and counting

Consume 40% of world’s energy

10-50% of consumption wasted

>$100bn savings opportunity
The energy transition

The traditional model of small number of centralized power generators is giving way to a large number of decentralised power generators typically driven by renewable energy sources such as wind turbines or solar power plants.


Connecting with demand

Energy digital transformation
Balancing challenges

Increase of Renewables Energy Sources (RES)

- RES are significantly impacting the power infrastructure
- RES are causing intermittency and volatility in the power supply
- This causes high peak energy prices reflected in the end-user bill
- And waste of RES and lower ROI
Balancing challenges

Increasing prosumers impact

- Increase of distributed generation systems
- Increase of Electric Vehicle Charging Loads

⚠️ The feed-in of electricity into grids by consumers includes more complexity in balancing demand and generation

⚠️ Energy flows are increasingly becoming bidirectional and less predictable

⚠️ In some instances, electricity companies are obliged to prohibit the addition of new energy sources like wind turbines and photovoltaic installations to their networks
Balancing challenges

Inefficiency and low ROI of some current power plants

Phasing out nuclear generation

Increase of renewables power plants ROI

⚠️ Our traditional generation capacity is dropping: energy producers are shutting down older and unprofitable plants

⚠️ Reverse flow power dams (PSH) are expensive to build and maintain

Virtual Power Plants, connected energy networks and the energy digitalisation opportunities workshop ● Luisa Matos ● Virtual Power Solutions Copyrights ● lmatos@vps.energy
Virtual Power Plants, connected energy networks and the energy digitalisation opportunities
Advances in ICT Technology
Smart meters, Internet of things, Big Data, Energy Blockchain...

Increasing role of active consumer behaviour¹
Greater customer choice - more clients want control over their electricity usage and spend, as well as when and what type of power they buy or the ability to self-generate and sell onsite power back to the grid.

The regulatory evolution

¹ The Energy Cloud, Emerging Opportunities on the Decentralized Grid, Navigant Research 2Q 2015
The Emerge of Automated Balancing Services

ICT plays an important role in smart grids by enabling monitoring and control of the energy flows in the grid at every level in the system, from large scale generation and transmission to the low voltage distribution networks in which residential end-users are located.

D. Geelen, A. Reinders and D. Keyson, Empowering the end user in smart grids: Recommendations for the design of products and services, Energy Policy 61(2013)151–161

An opportunity from ‘The Internet of Energy’…
Opportunity of ‘The Internet of Energy’...

Newness and opportunities from the digital transformation, helping:

- To build a dynamic infrastructure
- To integrate demand-side generation
- To integrate distributed storage
- To integrate electric vehicles
- To integrate loads flexibility

The emerging energy cloud will be far more dynamic, responsive, and democratized than what current infrastructure can support (Navigant, 2016)
Demand as a new energy asset

Need to
Control
What? Flexible loads

Forecast
What? Demand peaks
Distributed generation

Aggregate
How? Energy communities

Optimise
What? Loads, generation, and storage
Local or Virtual Energy Communities

A Virtual Power Plant (VPP) is a cluster of energy producers and energy consumers creating a **Virtual Energy Community**

- An Energy Community can act as a single operating entity on the energy market
- The members work together to be more sustainable
- They can share local energy production
- Loads can be managed to achieve community goals
- Distributed community storage capacity also
- The community will benefit together from cheaper energy prices
Sistemas de Gestão de Energia articulação com a norma ISO 50001
Contexto - ISO 50001

1. **Especificando os requisitos para uma organização estabelecer, implementar, manter e melhorar um Sistema de Gestão Energética**;

2. **Ayuda a gerir todo o fluxo de utilização de energia (desde o fornecimento até ao consumo de energia)**;

3. **Aplica-se a todos os aspectos que afetam o uso de energia, que podem ser controlados e influenciados**;

- Continualmente melhorar práticas de gestão energética
- Desenvolver uma política para um uso mais eficiente de energia
- Definir metas e objetivos em linha com a política
- Utilizar dados para tomada de decisões informadas sobre uso de energia
- Medir resultados para identificar áreas de melhorias na eficiência energética
- Avaliar a eficácia da política e resultados de melhorias
- Continuar a melhorar práticas de gestão energética
Develop a policy for more efficient use of energy
Fix targets and objectives in line with the policy

- Identificar situações de potencial redução de consumo e de custos
- Definir baseline para cálculo da poupança futura
Use data to make informed decisions about energy use

• Acesso a dados em tempo real:
  – Consumo
  – Produção
  – Temperatura
  – Outras variáveis...
Measure the results to identify areas of energy efficiency improvements.
Review the policy’s effectiveness and results of improvements

• Acompanhamento da evolução dos efeitos da aplicação das políticas energéticas, em diversos níveis da hierarquia de consumo
Continually improve energy management practices

- Definição de alarmes:
  - Identificação de anomalias
  - Valores fora dos setpoints definidos
  - (normalização com os parâmetros de atividade)
Continually improve energy management practices

• Definição de atuações:
  – Intervenção remota
  – Evitar consumos de desperdício
Continually improve energy management practices
Continually improve energy management practices
Assuring easy scalability of new platforms and services
Installation example
Installation example
Real time data, graphs and controls
Tariff Cycle Simulation
Example: Changing cycle this Client will save 1500€ per year.

Call to action with the Energy Retailer Contacts.

Simulation of fixed tariff versus indexed tariff to the spot market (in this case OMIE Market).

Power Factor Correction
Analyse if is necessary Power Factor Correction and give also the payback for this action if necessary.

Save Energy or Cost TIP
Heat Map

Monthly Heat Map
It's a big picture of the energy consumptions when is possible to find waste or abnormal behaviours.

Lower electrical consumptions compared with the other equivalent days.
Energy Management Service

A continuous process of energy management is crucial to maximize energy savings. To allow our clients to focus on their business without having to allocate teams to the process, VPS created an energy efficiency management and training unit to support them.
Direct Benefits

- Energy costs reduction
- Greater efficiency in management of maintenance equipment, and consequent increase of its lifetime
- Definition of Energy regulations, according to consumption profiles
- Central management of all facilities
- Reinforcement of sector’s sustainability policies along the following vectors:
  - Energy efficiency
  - Carbon footprint reduction

Indirect Benefits

- Improved working conditions for staff: air quality, lighting, conditions, etc.
- Improved corporate image with stakeholders - corporate sustainability and eco brand awareness
- Improved ecological awareness of staff
Connected Energy Networks

Manage Virtual Power Plants and Flexibility Pools

deploy Energy Communities

... take demand response to the next level
Utility platform

Data Features
- Aggregation of energy consumption
- Aggregation of distributed storage
- Aggregation of distributed generation
- Demand and generation forecast
- Demand flexibility aggregation

Business Features
- Real time management, analysis and planning
- Link to energy markets
- Economic performance reports for producers
- Individual power plants contracts management
- Energy assets performance analysis
Tools to create value for retailer and aggregator

Virtual Power plant manager
- Manage a Virtual Power plant
- Aggregate generation from distributed resources
- Solar, wind, hydro, micro-producers
- Sell generation in wholesale market
- Optimise pool of distributed generation

Flexibility Pool manager
- Participate in balancing and ancillary services markets
- Participate in demand side response programmes
- Improve retail margins
- Minimise imbalance settlements
- Optimise distributed energy flexibility
Create new value for your customer

Create new offers with Energy Communities

- Set new tariffs for the community members
- The community can benefit together from cheaper energy prices
- The community can benefit together from distributed flexibility optimisation (loads, storage, EVs,...)
- Member can share local energy production and benefit from reduced transmission fees
- The members work together to be more sustainable
- An Energy Community can act as a single operating entity on the energy market
Retailer and aggregator

Building VPP for generation aggregation and market operations management

- Working with Simples since 2014
- Developing “customized” VPP platform for generation aggregation and market operations management
- Integration of TSO data
- Data integration from Hydro, Wind and Solar Power Plant monitoring systems
- Generation forecast integration
- Big generation for Day-ahead and Intra Day
Galp Energy Manager

Energy real time monitoring and remote control in Industries

- Working with Galp since 2006
- Deployment of an energy flexibility and energy optimization service in 150 industries
- Setting alarms to detect abnormal consumptions
- Programming tasks and remote control selected circuits and devices in real time
- Automatically moving loads for specific times when energy is less expensive
Skipper CE Project

Real time monitoring and management of EDP Generation in all its hydro power plants in Portugal

- Working with EDP since 2008
- Develop a complex energy generation monitoring system
- Development of specific software modules to integrate monitoring devices with OSI PI system through DLMS protocol and Landis&Gyr FAG (SCTM) support
- Monitoring more than 1000 points
Energy Performance Contract

Efficiency and Flexibility Management in Bank Branches

- Working with Banco Popular since 2014
- Monitoring and remote control in 170 bank branches
- Data collected and remote control includes
  - Total active electricity consumption
  - HVAC electricity consumption and remote control
  - Outdoor advertising monitoring and control
  - Indoor lighting monitoring and control
  - Ventilation monitoring and control
- Energy Efficiency savings up to 15%
- Flexibility management savings additional 7%
Energy Community Platform

- Deployment of local energy communities:
  - Public buildings
  - Schools
  - Sports facilities
  - Library building
  - 100 Homes

- Orchestrate Real-time Distributed Energy Resources Optimisation:
  - Flexible loads
  - Renewables
  - Storage

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Platform

Energy Community Platform
Data collection and aggregation to enable VPP

Developing customized new UI for aggregator
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<th>Vila Real</th>
<th>Alfândega da Fé</th>
<th>Penela</th>
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4 Edifícios Municipais com sistema de monitorização e/ou produção

50 Residências de Munícipes Implementação de Sistema de Monitorização.
Biblioteca Municipal de Alfândega da Fé

Mercado Municipal de Alfândega da Fé
Cenários e casos de uso

Municípios +Autónomos:

- Redução dos custos de energia no município por meio da geração de eletricidade por meio de fontes renováveis locais, eficiência no consumo e programa de partilha de energia com os munícipes

- Medidas incluem:
  
  - Edifícios municipais de baixo carbono
  
  - Plano de autonomia energética municipal
  
  - Plano comunidade municipal de partilha energética
  
  - Plano iluminação pública eficiente
Cenários e casos de uso

*Plano comunidade municipal de partilha energética*

Este plano permite às famílias residentes no município acederem a contratos de energia elétrica em condições mais vantajosas, ao abrigo de um protocolo celebrado com a Energia Simples

*Política social de partilha de energia*

Este plano permite partilhar a produção de energia local com os munícipes. Nos momentos em que a produção é superior ao consumo (p.e. fins de semana), quem adere ao programa terá acesso a essa energia através de descontos na fatura de energia elétrica proporcionais ao excedente da produção de energia renovável

*Política de envolvimento dos utilizadores dos edifícios municipais*

Este programa atribui descontos na fatura de energia elétrica proporcionais aos obtidos na instalação dos edifícios municipais para todos os funcionários que tenham aderido ao Plano Comunidade
Política de envolvimento das famílias

Famílias com os filhos a frequentarem estabelecimentos escolares municipais terão acesso a descontos na fatura de energia elétrica, proporcionais às poupanças registadas nesses estabelecimentos.

Plano de autonomia energética municipal

Este Plano Município Solar permite aos municípios reduzir a fatura de eletricidade, aumentar a autonomia energética e diminuir a emissão de dióxido de carbono, através da implementação de centrais fotovoltaicas nos edifícios da administração pública, escolas entre outros.
Público Alvo

Agregadores e comercializadores de energia (Energia Simples):
Possibilidade de oferecer aos seus clientes uma proposta de valor acrescentado e diferenciador, relativamente à sua concorrência, ao mesmo tempo que beneficia da partilha e dos benefícios da gestão centralizada da produção distribuída

Utilizadores em ambiente residencial
Comunidades residenciais – no âmbito deste projeto serão 50 residências

Ambiente comercial/empresarial
Grandes clientes com edifícios distribuídos no território, designadamente, bancos com suas diferentes agências, cadeias de hotéis, empresas de gestão de habitação social, municípios, aeroportos, universidades, comunidades, etc...

Edifícios públicos
Escolas, bibliotecas, câmaras municipais, etc...
**ESCOLAS**

**Município de Águeda** (escolas 1º ciclo):
Barrô: - 42%, Recardães: - 30%, Arrancada: - 11%, Chãs: - 7%
Mobility
Real Time
UX Inclusive Design
Remote Control
Plug&Play
Interoperability

Linking homes with low cost HEMS
Plataformas do utilizador final
Partilha de energia

• Ganho de 0,0451 €/kWh no excedente da produção fotovoltaica, ou seja, redução de 27%
• Simulações para 2017 resultaram num abatimento médio de 3,5€/mês em cada fatura de energia, para uma comunidade com produção fotovoltaica em 4 edifícios públicos (prosumers) e 40 residências (consumers only)
Conclusão

• Passos em direção à uma **SOCIEDADE DE BAIXO CARBONO** – redução das emissões de carbono

• **GERAÇÃO DE NOVAS OPORTUNIDADES** econômicas e de uma administração pública sustentável com base em valores compartilhados e governança colaborativa

• **GERAÇÃO DE CAPITAL SOCIAL** - impactos positivos no bem-estar dos cidadãos, uniformização dos valores comunitários e reforço dos laços de identidade local (senso de pertencimento, *empowerment*, participação, confiança, propósito comum, etc.)

• **FOMENTAR** o desenvolvimento da legislação em prol da partilha de energia
VPP at the company level with 120 branches

Minimise
Energy Efficiency
- Energy consumption
- Eliminate ‘wasted’ energy

Optimise
Load Management
- Energy resources
- Renewables & Storage
- Flexibility
- New Earnings for End-users

- Simulation by changing from TOU tariff to RTP
- + Associate Real-time distributed energy resources optimisation (Automated HVAC load control)

Monetise
Demand Response
- Additional 15%
- Additional 7%
- Additional 34%
Current and planned developments

Interaction with National Grid DSR schemes
Integration with Batteries
Machine learning
Create new value for utilities

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Energy Communities & VPP platform

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Developing customized new UI for aggregator
Integration with Batteries

✓ Strong experience integrating with both controllers and API from third party providers
✓ Strong experience in integrating standard protocols

- Modbus
- DLMS COSEM
- Profi bus
- M-Bus
- CANOpen
- CAN
- Zigbee
- RS485
- RS232
- Among others
Machine Learning developments

- Challenges that we are addressing
  - Improve and optimise Energy Management service (domestic, buildings and industry)
    - Improve consumption forecasts
    - Identify abnormal consumption and malfunctions
    - Develop model predictive control
  - Improve and optimise Flexibility Pool & VPP management
    - Improve aggregated consumption and generation forecasts
    - Set optimum flexibility events without compromising comfort and operational requirements of users

Example of load shed in a bank branch

Algorithm simulation

Real impact
Some lessons learned

It is not only about technology development...
and it is more than having end-users engagement...
... Is about new value discovery
... designing new business models
... and a great deal of transformation of the energy players
What is missing?
We have a long road ahead... 
...with great challenges 
...regulatory changes 
...transformation of the energy players 
...new value discovery 
...new business models 
...new market design 
...new players
New challenges ahead?
The transactive grid & Blockchain
Energy blockchain

Blockchain is a special technology for peer-to-peer transaction platforms that uses decentralised storage to record all transaction data (PwC, 2016)

Source: Transactive grid
Our research partners
Thank you

Energy connected networks

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