VPS
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Sistemas de Gestão e Troca de Energia

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

José Basílio Simões
Ordem dos Engenheiros
Lisboa, 25/01/2018

Virtual Power Solutions

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

Technologies

- Internet of Things (IoT)
- cloud and mobile applications
- M2M platforms
- hardware and software

Products & Services

- kiplo™ — For utilities & aggregators
- kisense ENERGY OPTIMISER — For industrial & comercial buildings
- Cloogy — For domestic users & small business

Value for the Market

History of pioneering and market leadership

1990

2000

Pioneering cloud based oil & gas metering solution (SaaS)

SaaS becomes mainstream 10 years later

ESaaS becomes mainstream in 2013

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

2010

ISA Intelligent Sensing Anywhere

GREEN PROJECT AWARDS

Gartner 2012 CoolVendor

2012

Cloogy® launch (domestic EMS & ADR solution)

2014

ALISA LISTED NYSE ALTERNEXT

ISA Energy

Paving the way for market development

Pioneering Active Demand Management with energy community aggregation services

2015

2017

Kiplo® market deployment (new VPP user interface)

VPS Virtual Power Solutions

2020

Supporting energy transition

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

Harnessing the potential of Energy Distributed Resources and Demand Response

Powering a pro-active future

bp, REPSOL, Shell, TOTAL, PRIMAGAZ, Butagaz, galp, BANCO POPULAR, NOVO BANCO, Millennium bcp, edp produção, VINCI AIRPORTS, ANA Aeroportos de Portugal, S'mples energia, PESTANA HOTELS & RESORTS

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)

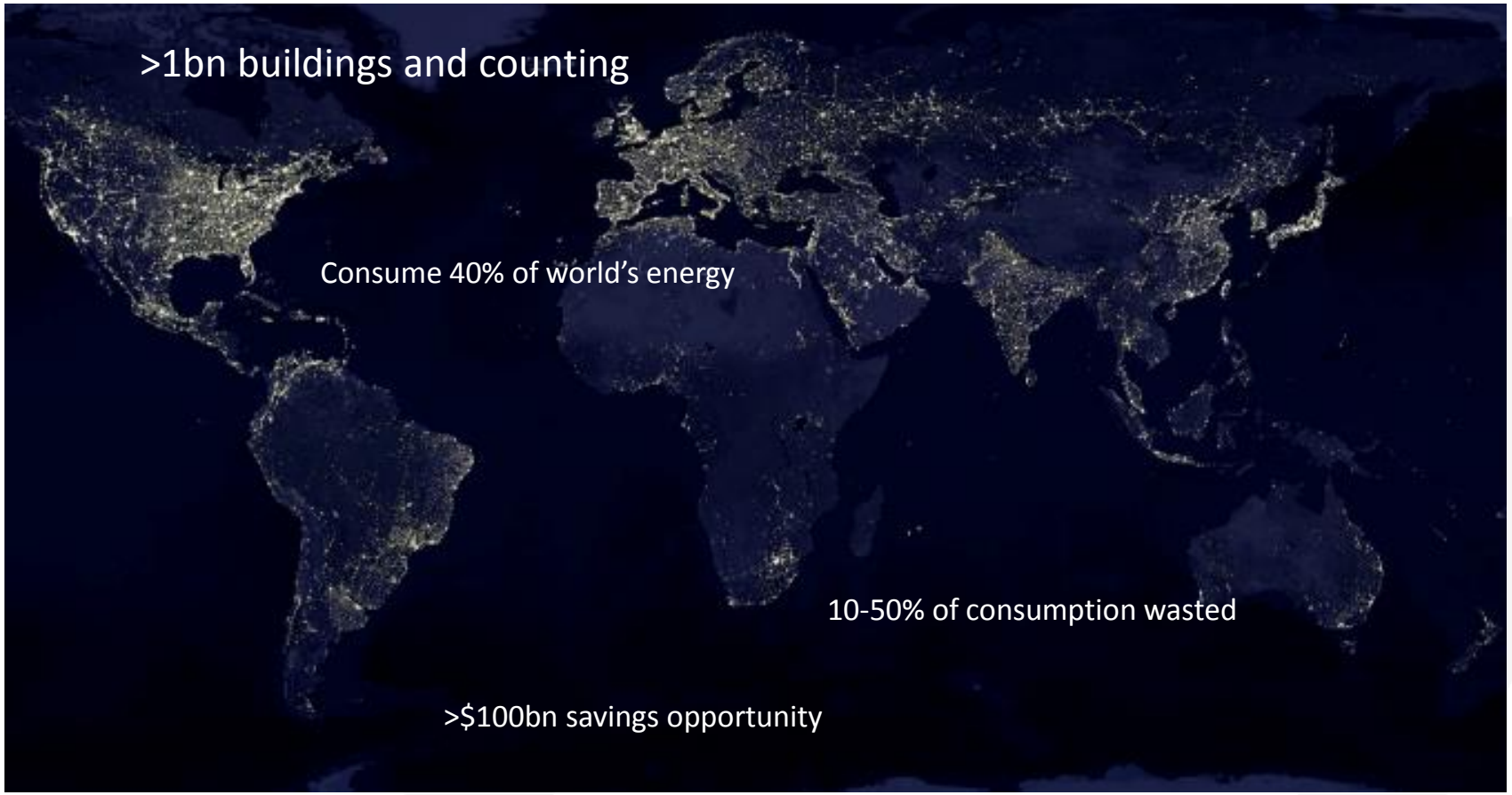
VPS

Virtual Power
Solutions

Agenda

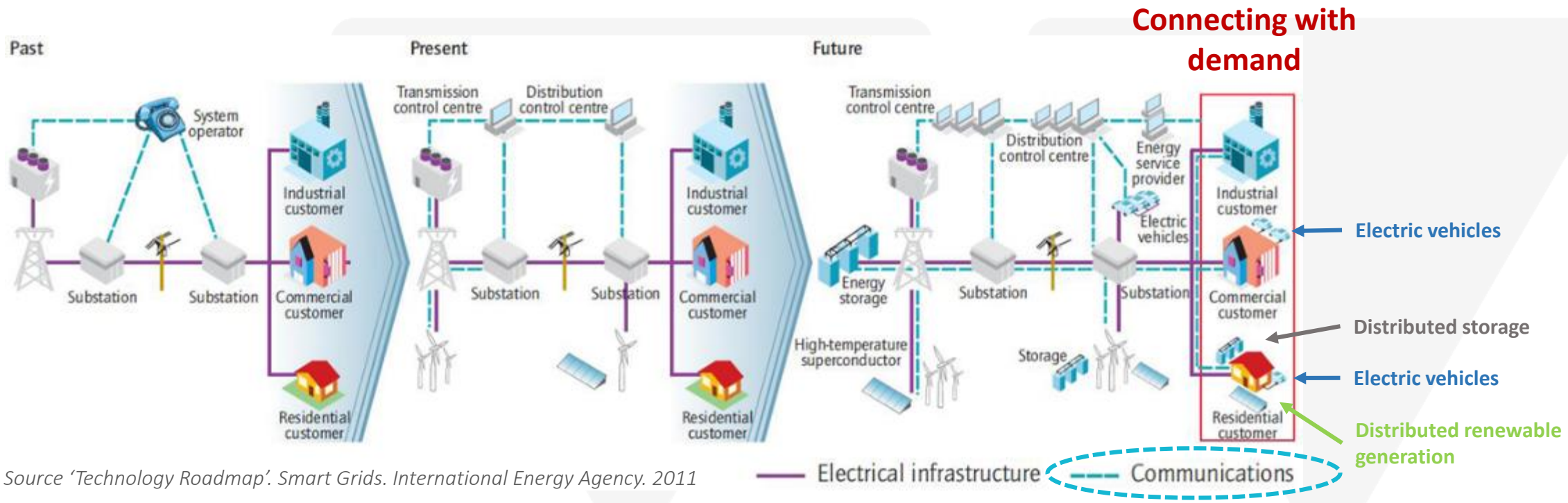
1. **Virtual Power Solutions presentation**
   - VPS background and key competences
   - Reference projects
2. **Transição energética – necessidade e oportunidade de mercado**
   - Renováveis e produção descentralizada
   - Eficiência energética, controlo da procura e balanceamento da rede
   - Digitalização 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



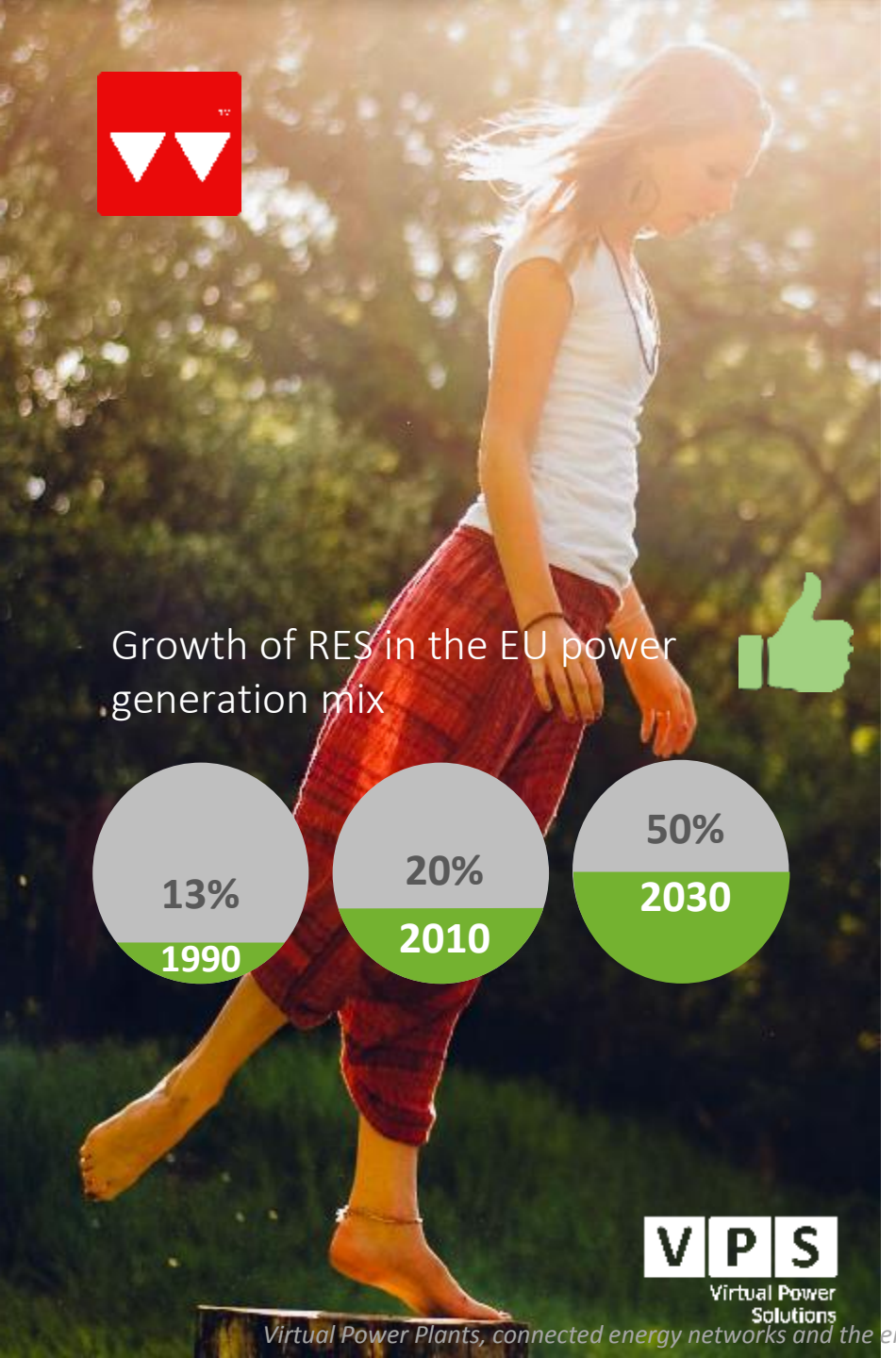
The energy transition

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.



Source 'Technology Roadmap'. Smart Grids. International Energy Agency. 2011

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

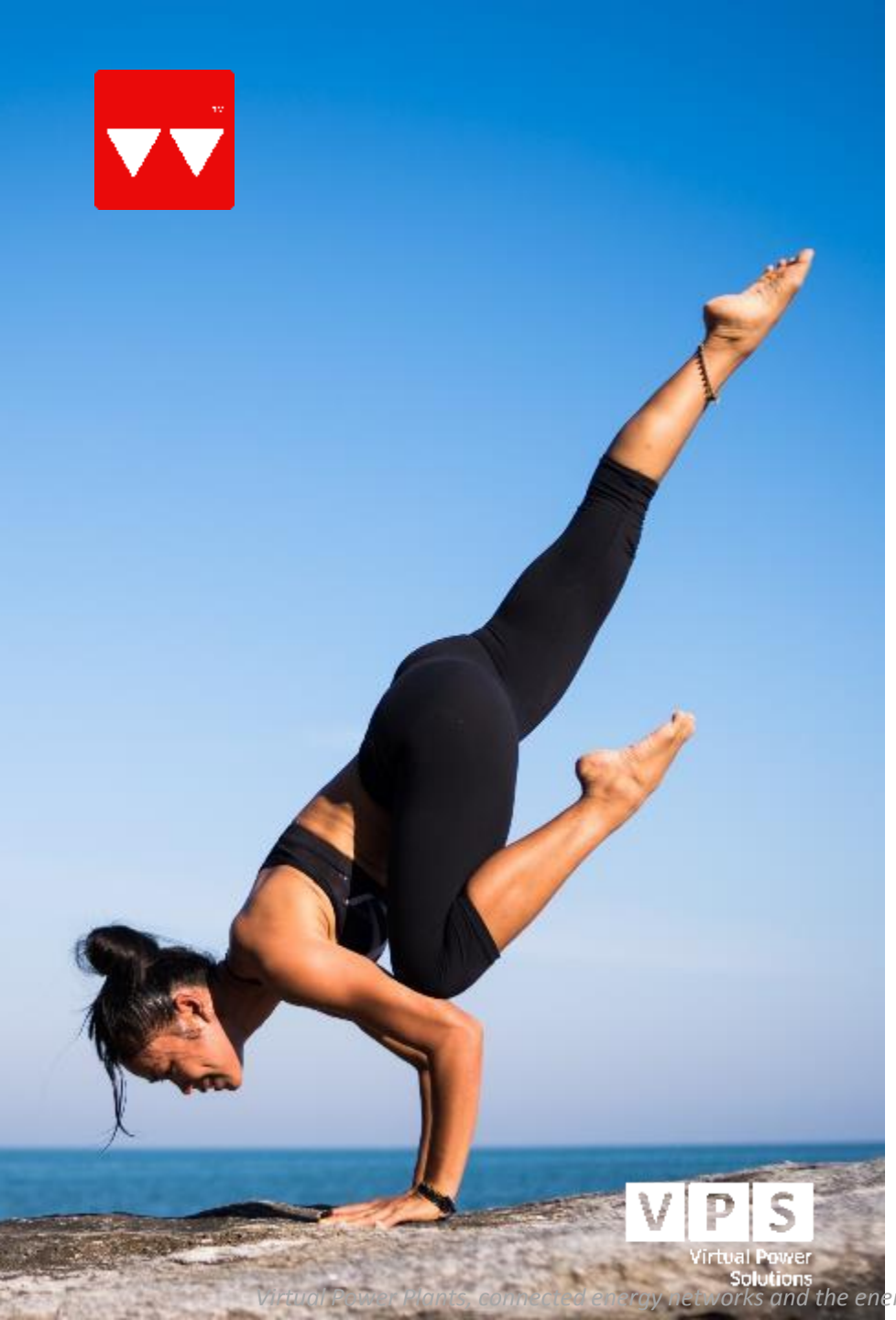
Increase of distributed generation systems ✓

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 built and maintain

Virtual Power Plants, connected energy networks and the energy digitalisation opportunities

Smart Grids enablers

Advances in ICT Technology

Smart meters, Internet of things, Big Data, Energy Blockchain…

Increasing role of active consumer behaviour[1]

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

Energy Communities - proposal for the future Directive of the European Parliament and of the Council on common rules for the internal market in electricity.

[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

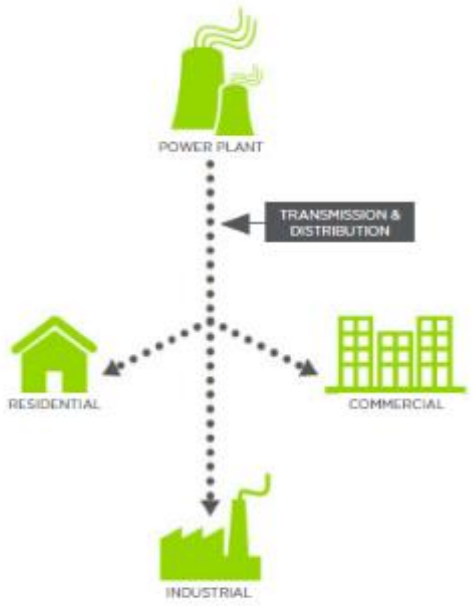
An opportunity from 'The Internet of Energy'…

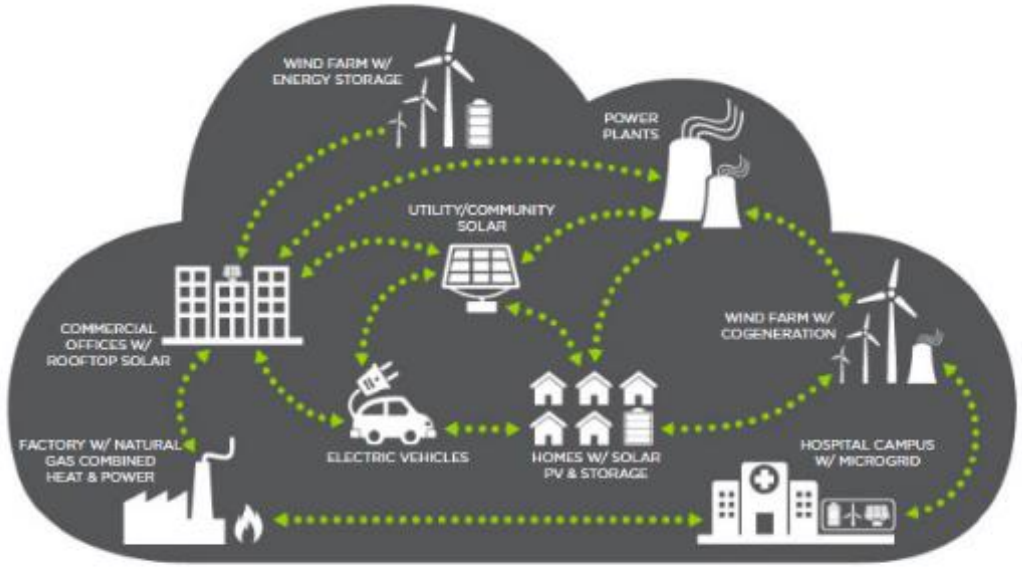
Opportunity of 'The Internet of Energy'…

…Energy digital transformation

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

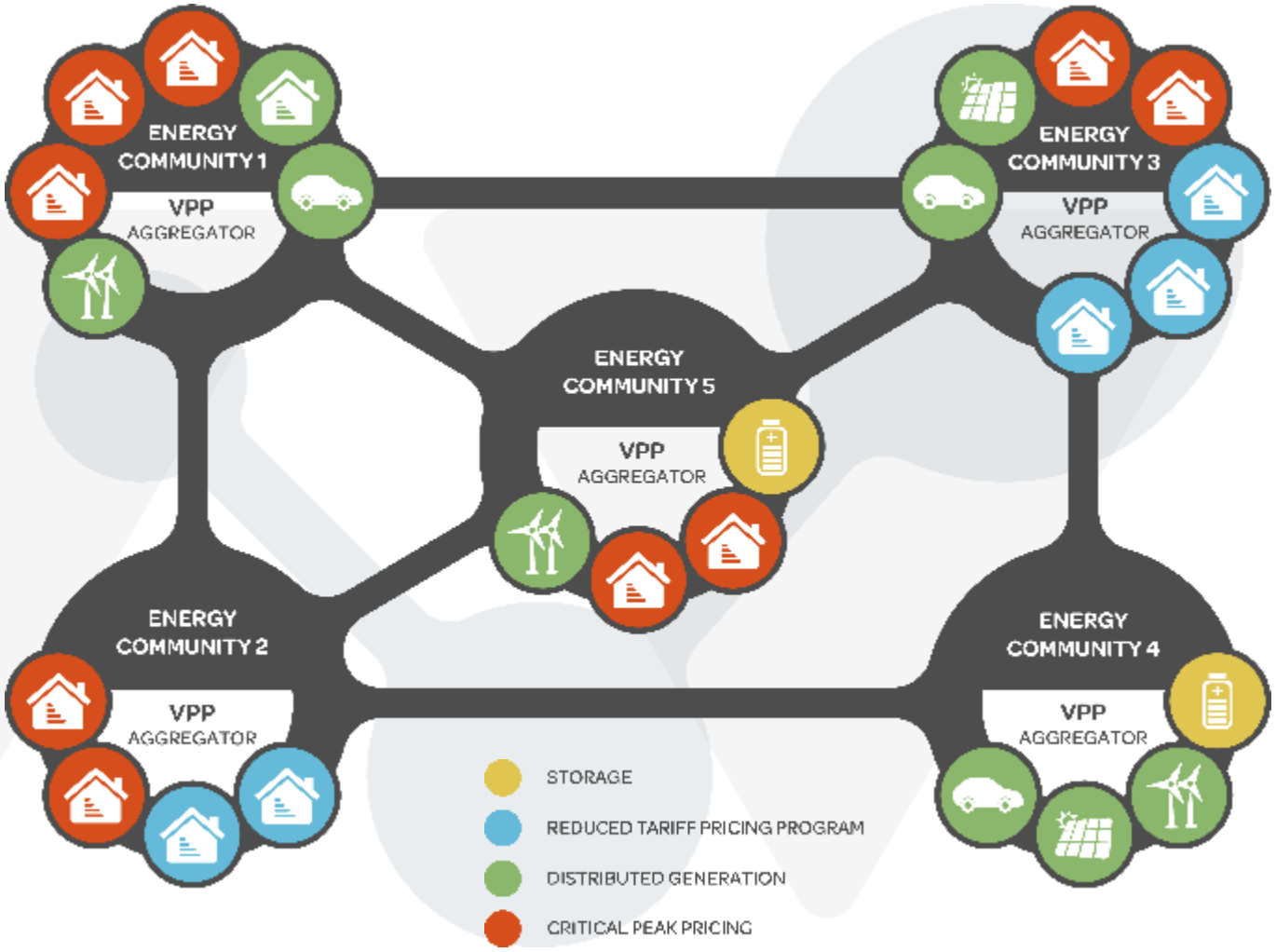
Optimise

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

- Especifica os requisitos para uma organização estabelecer, implementar, manter e melhorar um Sistema de Gestão Energética;
- Ajuda a gerir todo o fluxo de utilização de energia (desde o fornecimento até ao consumo de energia);
- Aplica-se a todos os aspectos que afetam o uso de energia, que podem ser controlados e influenciados;

Develop a policy for more efficient use of energy

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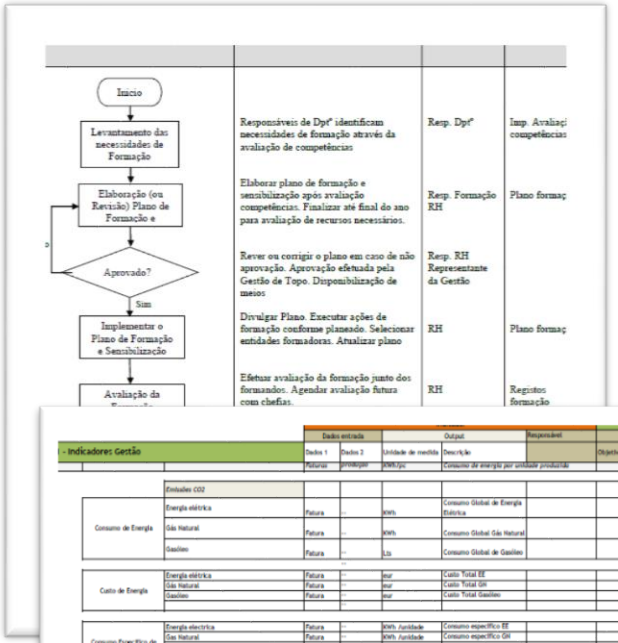
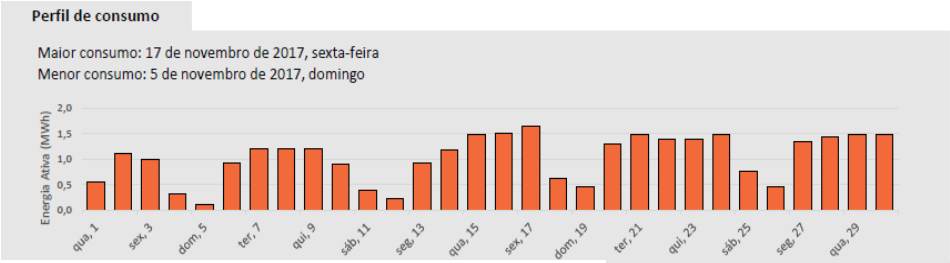
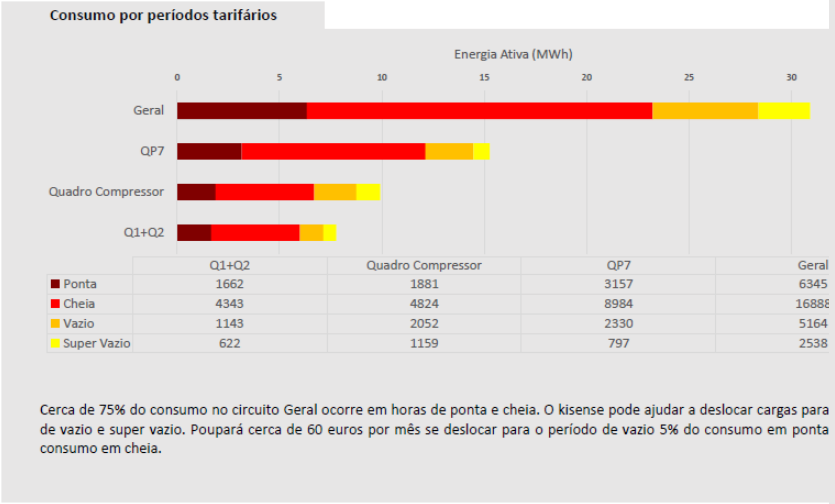
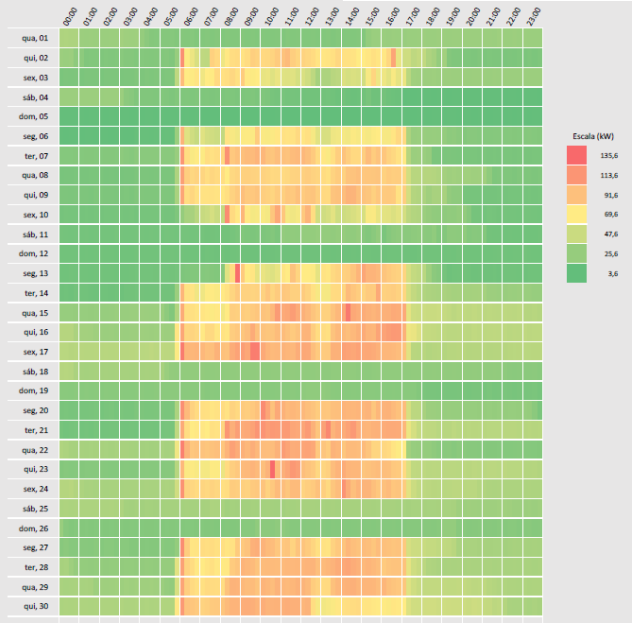






	Q1+Q2	Quadro Compressor	QP7	Geral
Ponta	1662	1881	3157	6345
Cheia	4343	4824	8984	16888
Vazio	1143	2052	2330	5164
Super Vazio	622	1159	797	2538

Cerca de 75% do consumo no circuito Geral ocorre em horas de ponta e cheia. O kisense pode ajudar a deslocar cargas para de vazio e super vazio. Poupará cerca de 60 euros por mês se deslocar para o período de vazio 5% do consumo em ponta consumo em cheia.



Fix targets and objectives in line with the policy

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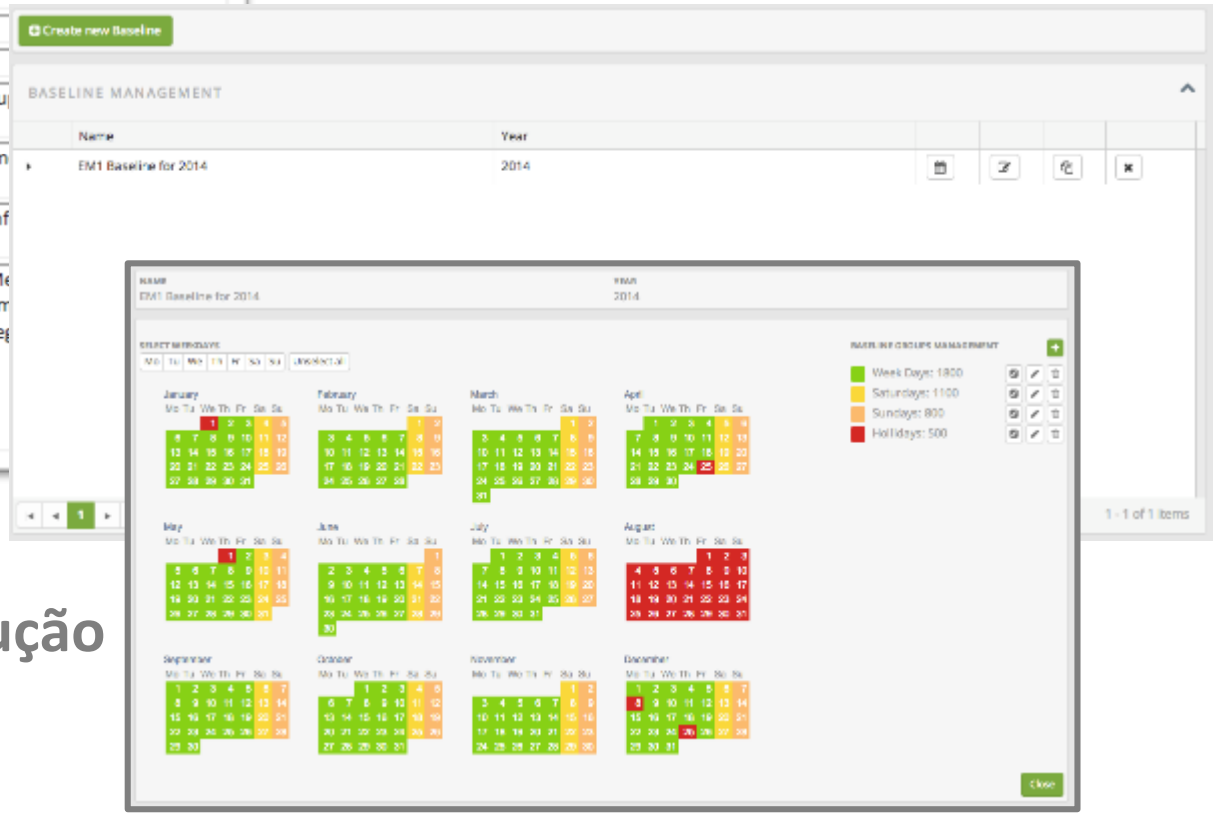
Critérios de priorização de oportunidades

CRITERIOS	Classificação e descrição			
	1	2	3	
A - Poupança anual prevista	Inferior a 10,000 eur/ano	€10,000-€25,000/ano	€25,000-€100,000/ano	Su
B - Tempo expectável para a implementação	Superior a 12 meses	6-12 meses	Inferior a 6 meses	Im
C - Payback	Superior a 36 meses	13-36 meses	6-12 meses	Inf
D - Impacto em termos Ambientais, Saúde e Segurança	Aumento do impacto negativo nas condições ambientais, saúde ou segurança	Impacto negativo mínimo nas condições ambientais, saúde ou segurança	Sem alteração no impacto nas condições ambientais, saúde ou segurança	Me am seg



- **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

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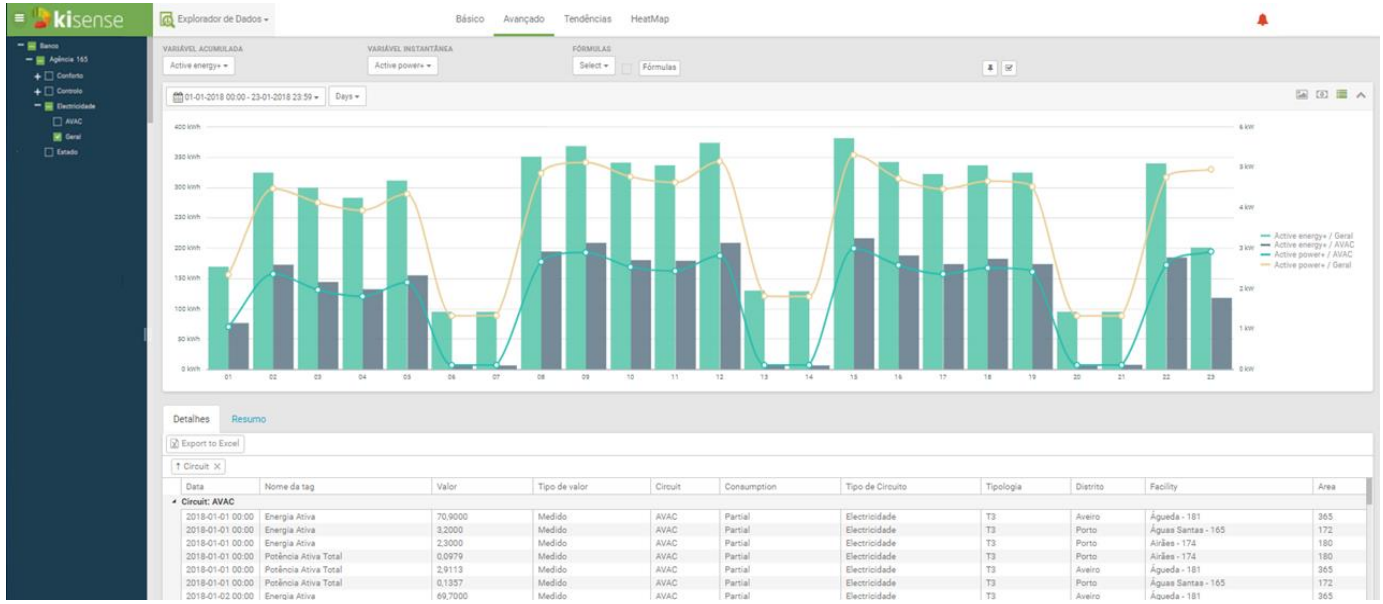

- **Acesso a dados em tempo real:**
  - Consumo
  - Produção
  - Temperatura
  - Outras variáveis…

Measure the results to identify areas of energy efficiency improvements

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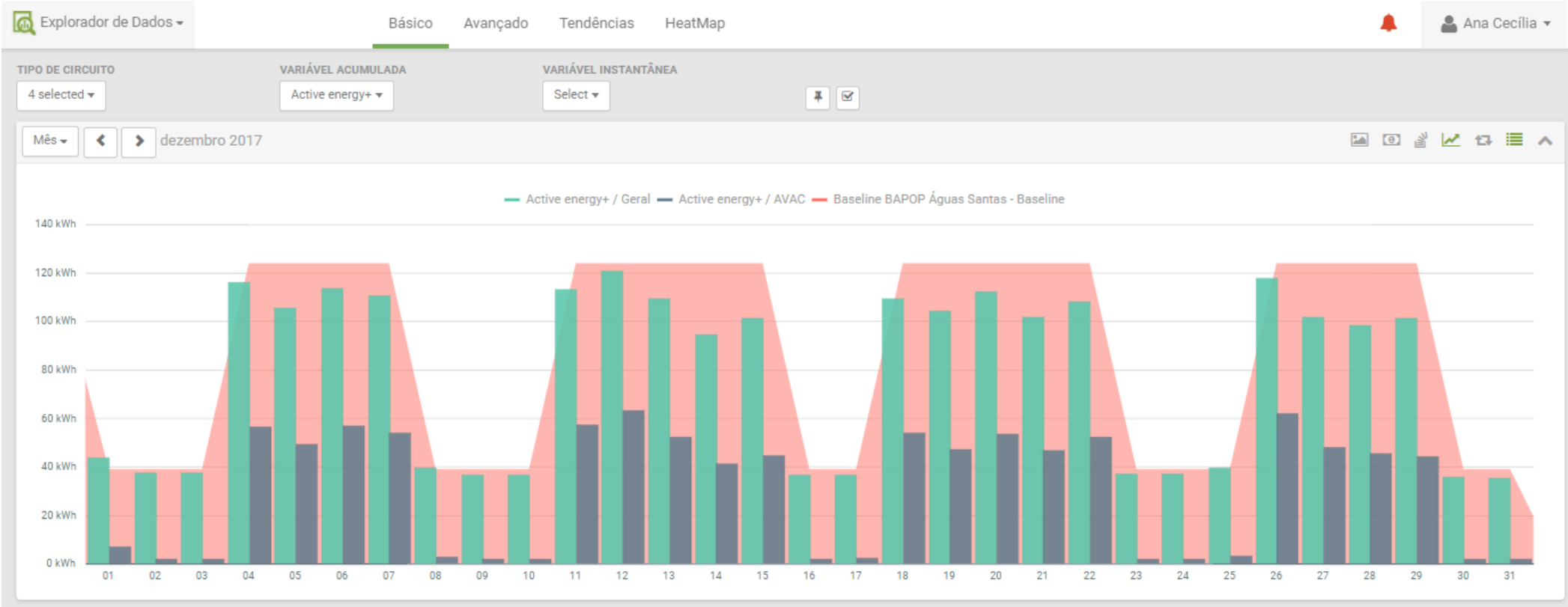

Review the policy's effectiveness and results of improvements

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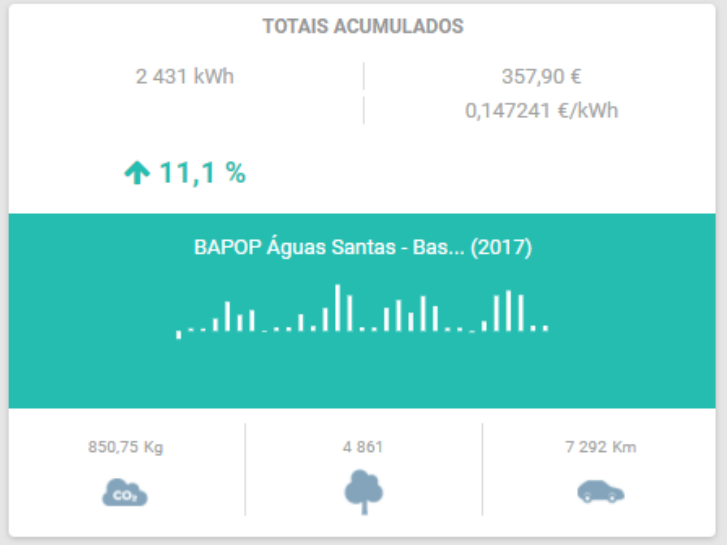
Evolução do consumo

Consumo em novembro de 2017:

Circuito	Consumo mensal *kWh*	Consumo diário *kWh/dia*	Variação do consumo diário face a: out/17	nov/16
Geral	30 935	1 031	-9%	-32%
QP7	15 267	509	+38%	+90%
Quadro Compressor	9 915	331	-14%	
Q1+Q2	7 770	259	-22%	-69%

Disponibilize os dados de produção da sua indústria para que lhe facultemos mensalmente o indicador



- **Acompanhamento da evolução dos efeitos da aplicação das políticas energéticas, em diversos níveis da hierarquia de consumo**

Continually improve energy management practices

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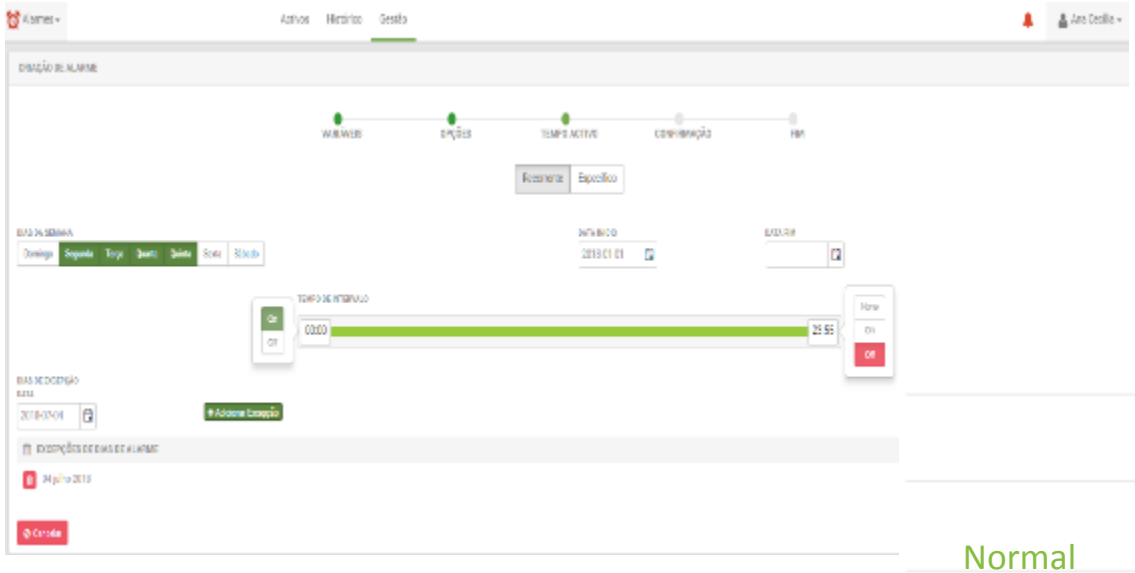

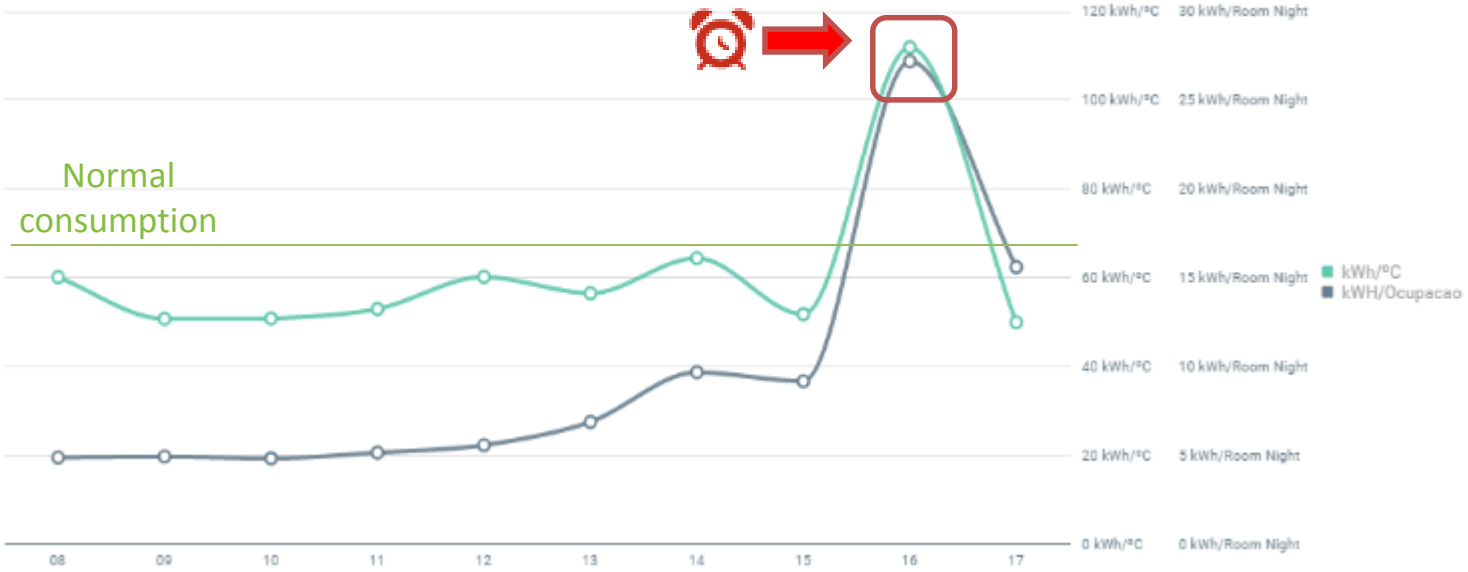

- **Definição de alarmes:**
  - Identificação de anomalias
  - Valores fora dos *setpoints* definidos
  - (normalização com os parâmetros de atividade)

Continually improve energy management practices

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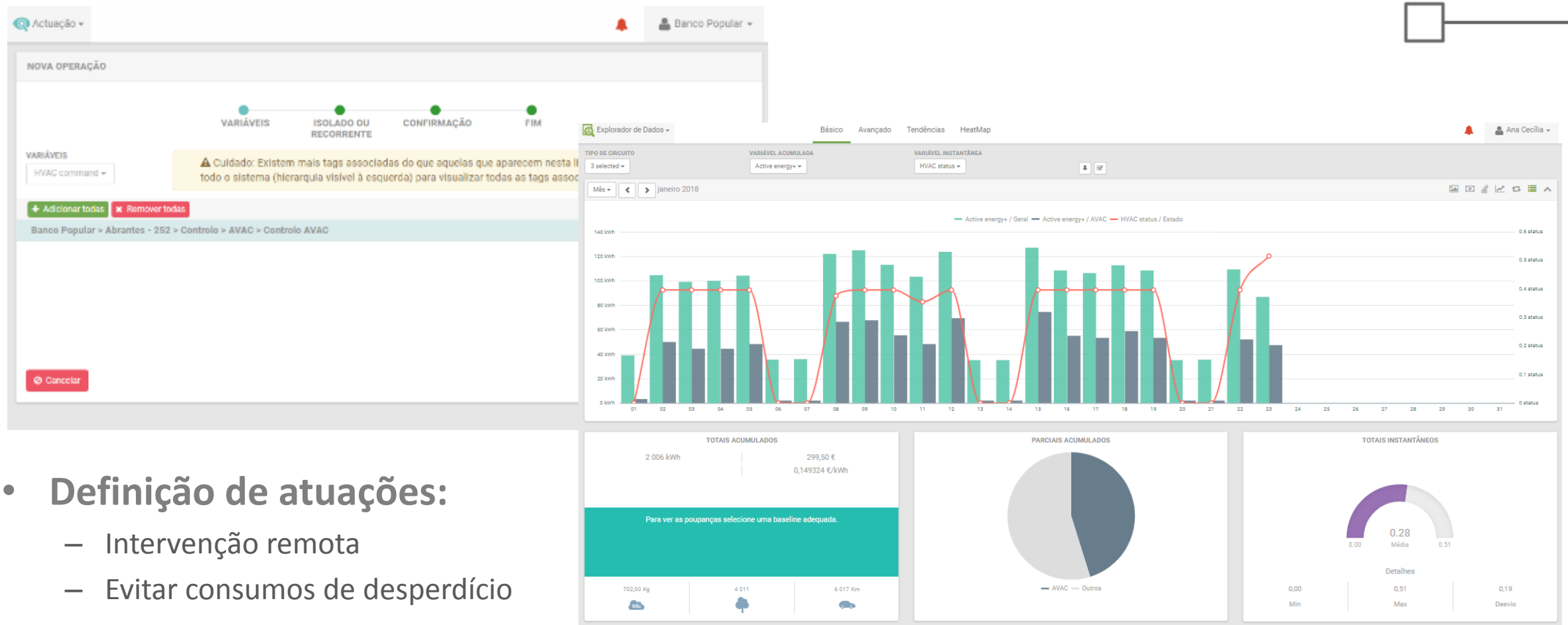

- **Definição de atuações:**
  - Intervenção remota
  - Evitar consumos de desperdício

Continually improve energy management practices

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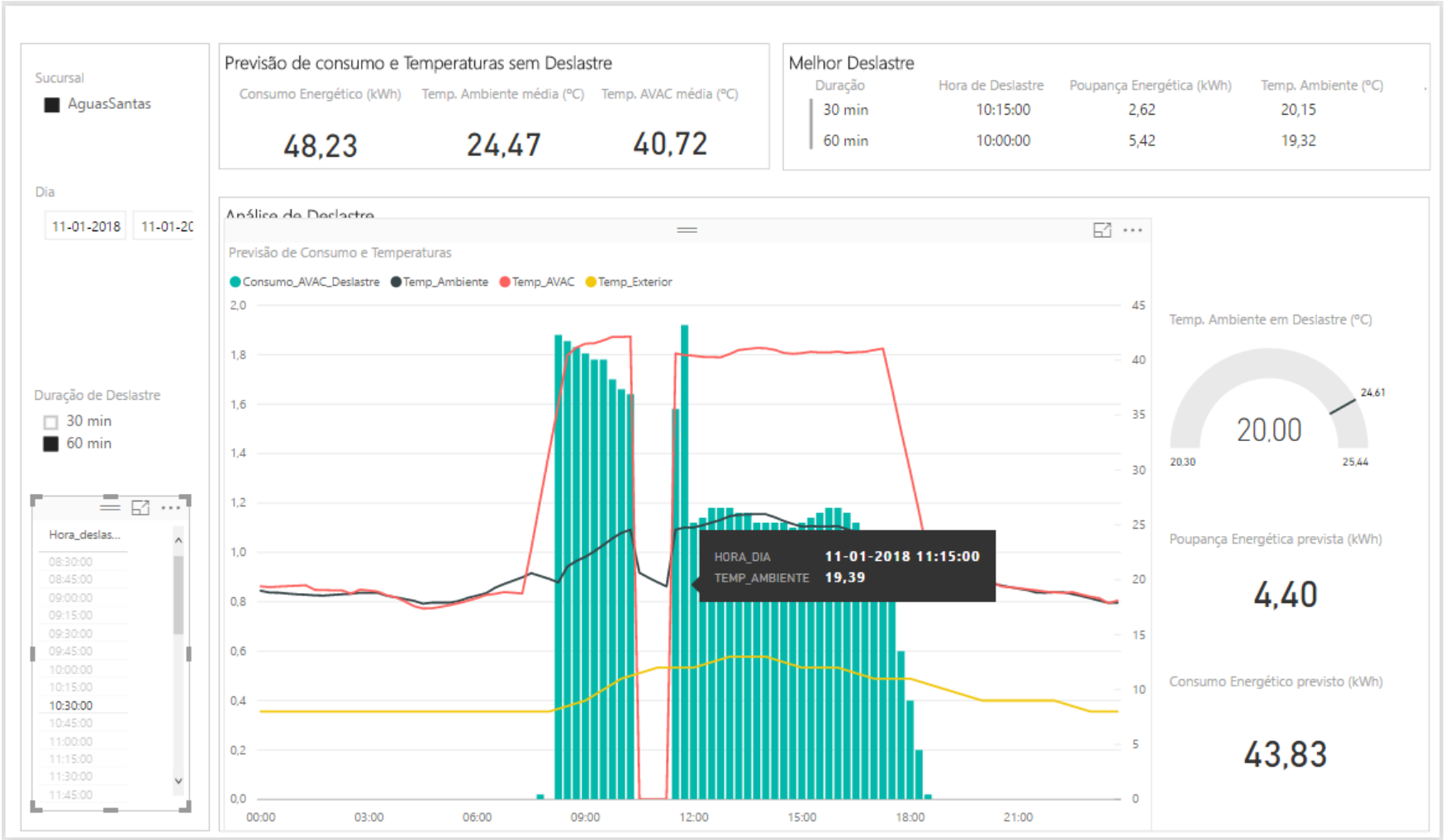

Continually improve energy management practices

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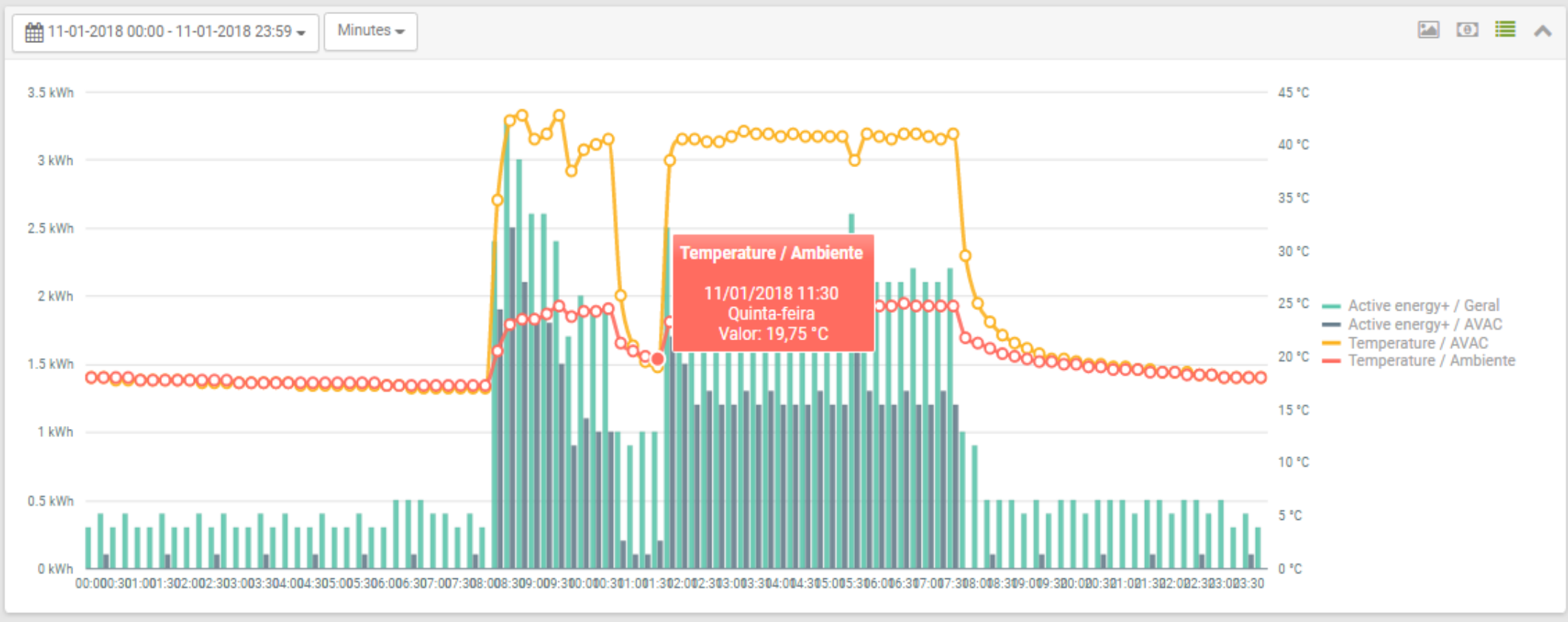
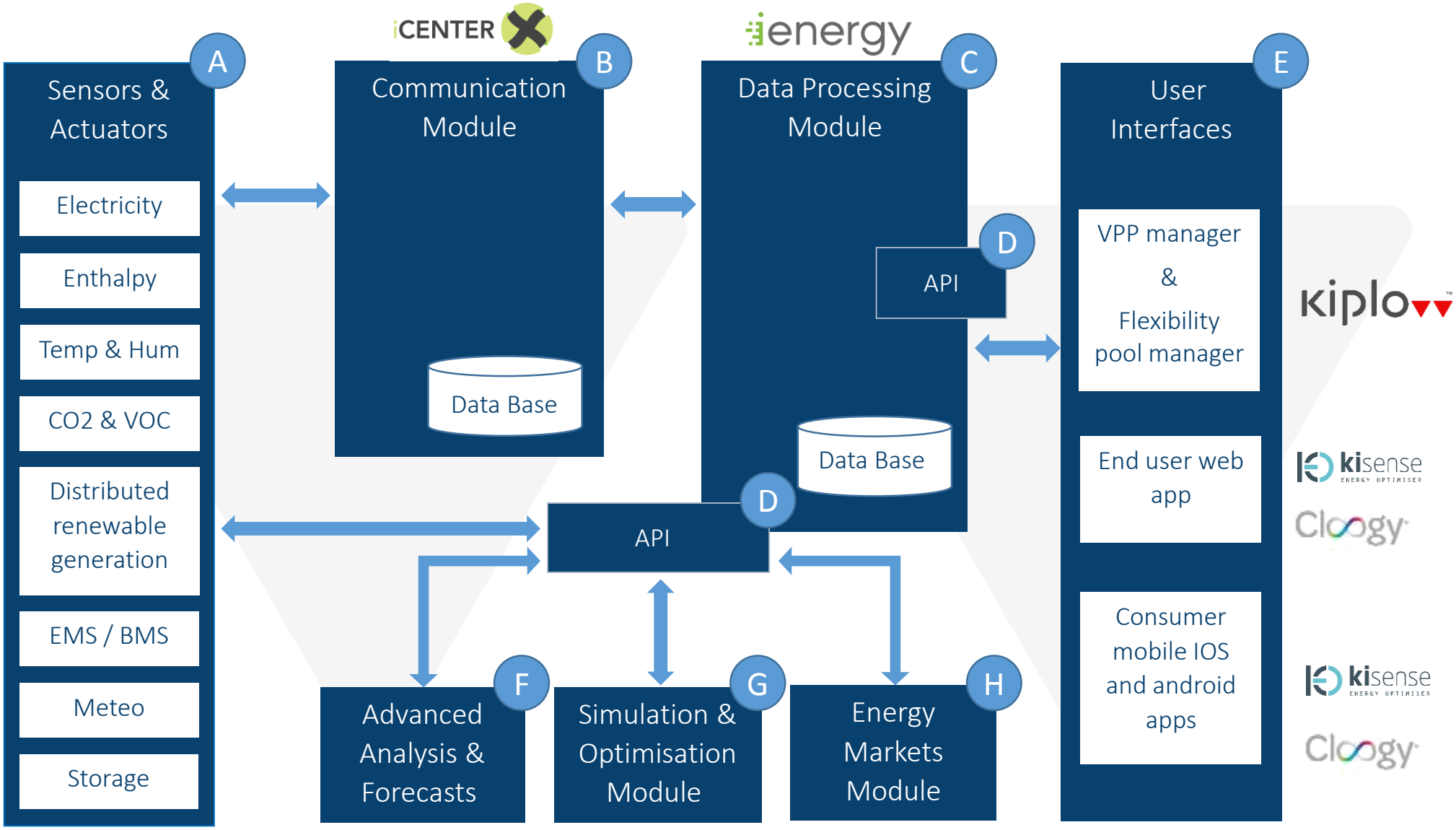
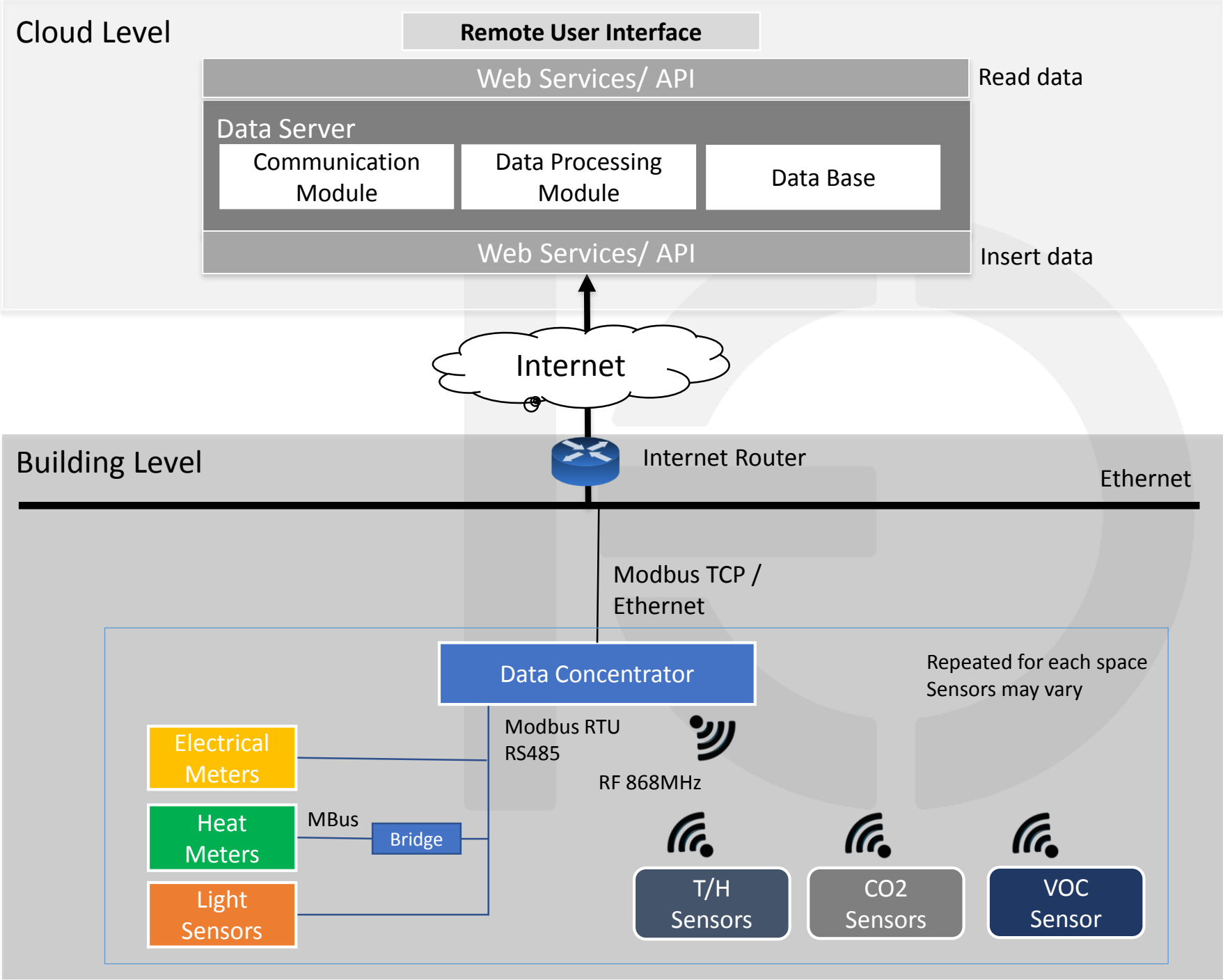


Architecture

Assuring easy scalability of new platforms and services



Installation example



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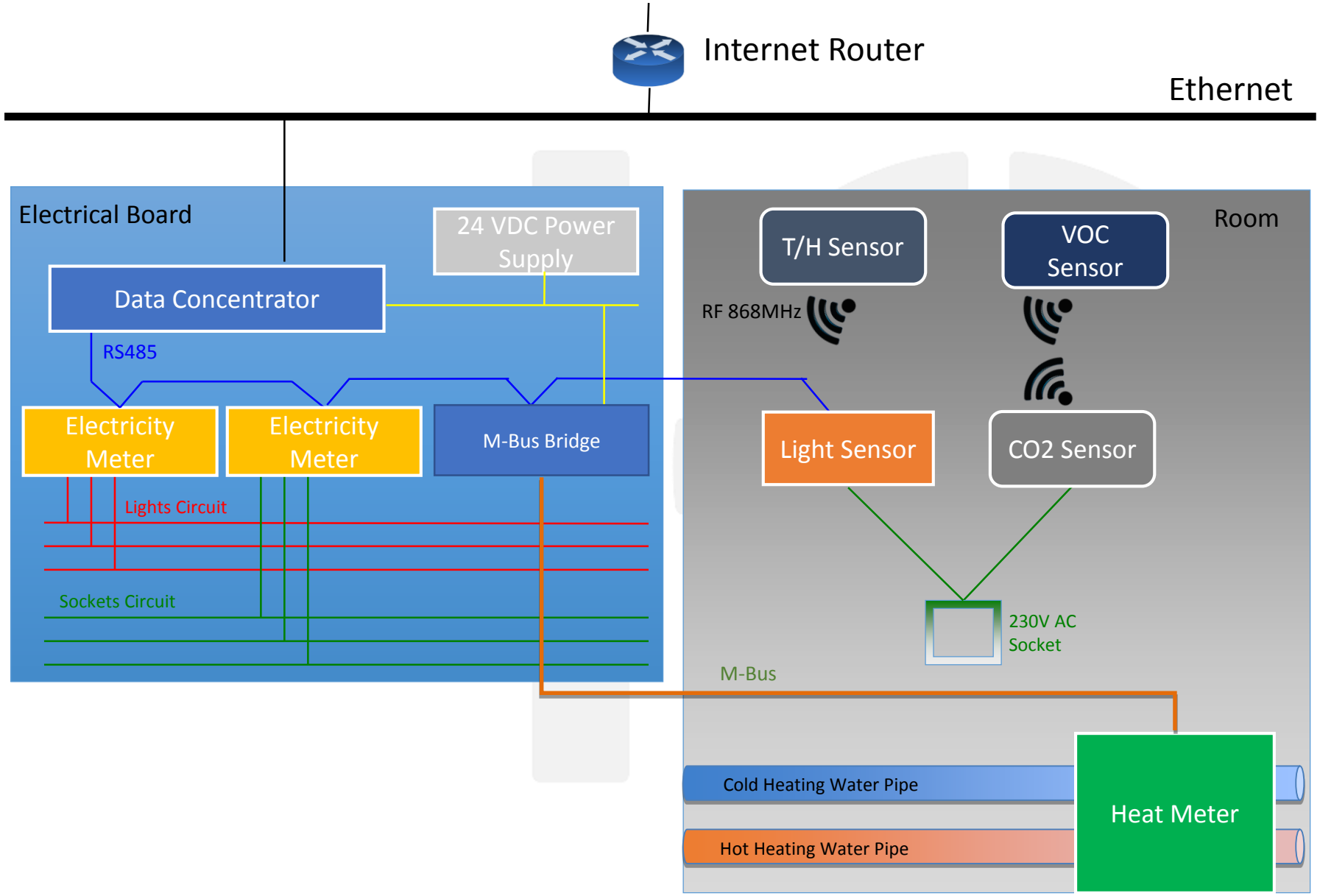
Installation example



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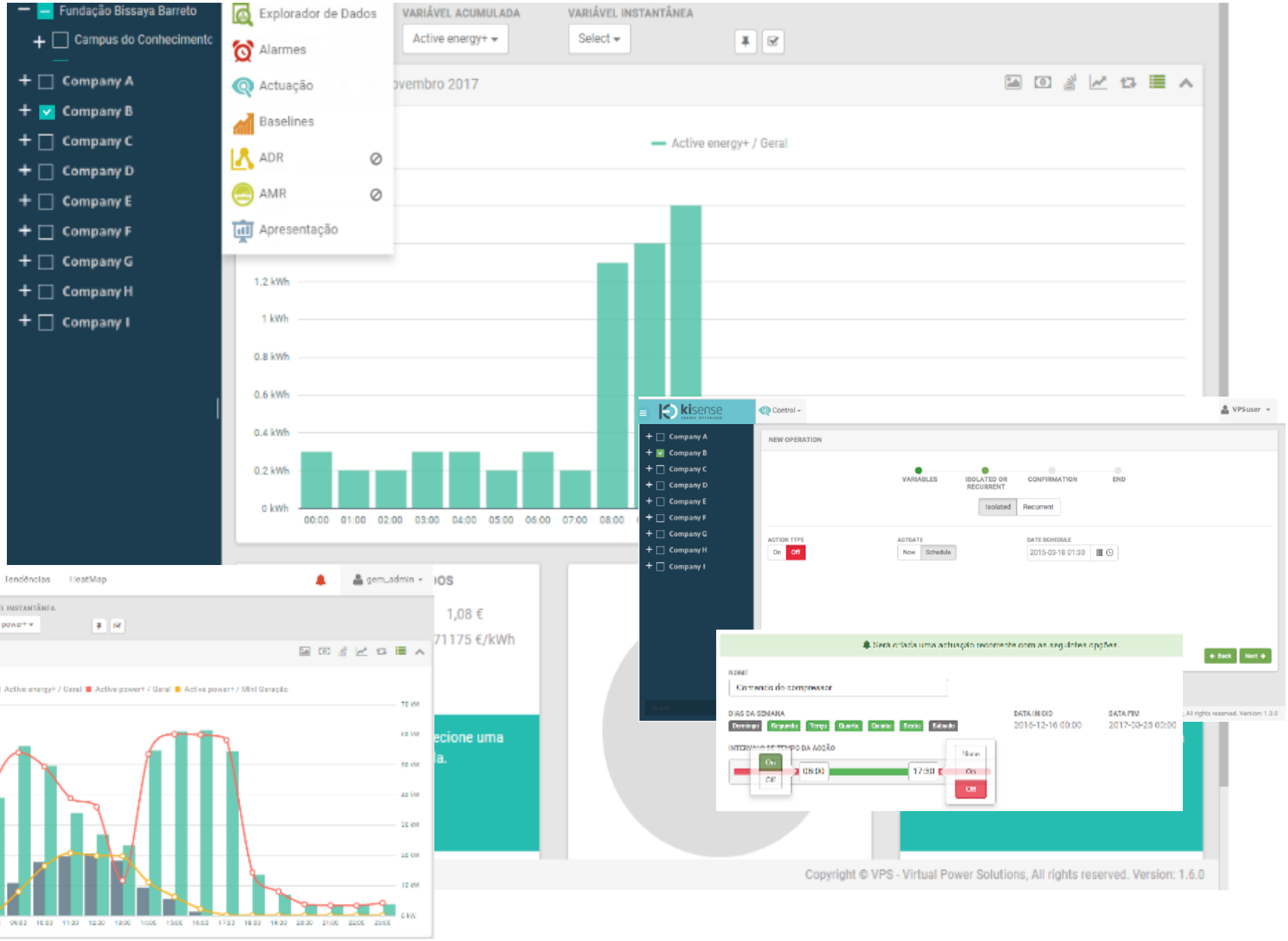
Real time data, graphs and controls

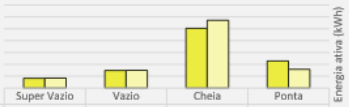


Monthly Reports

Análise do ciclo horário

Consumo entre 01/06/2016 e 31/05/2017:
(relativo a 365 dias)

	Semanal	Semanal opcional
Energia ativa	€16 866	€16 794
Potência horas ponta	€4 589	€3 166
	21 455 €	19 960 €



	Super Vazio	Vazio	Cheia	Ponta
Semanal	16 536	29 589	100 852	45 843
Semanal opcional	16 811	30 038	114 347	31 624

Atendendo ao seu perfil de consumo, se transitar para o ciclo Semanal Opcional poderá poupar cerca de 1 500 euros por ano.

Para mais informação contactar: empresas@energiasimples.pt / 800 917 538 (linha gratuita)

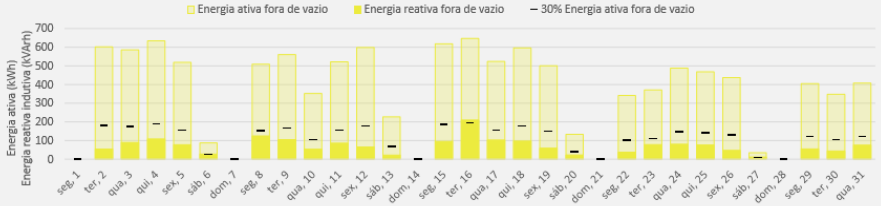
Análise tarifa indexada

Período	dados disponíveis	Energia Ativa consumida	Custo estimado: Tarifa fixa (atual)	Custo estimado: Tarifa indexada (k = 5)
01/06/2016 a 31/05/2017	365 dias	192 302 kWh	9 722 €	11 585 €
maio 2017	31 dias	14 683 kWh	741 €	834 €

Considerando o seu perfil de consumo determinamos que a tarifa indexada não é a opção mais económica a longo termo.

Fator de potência

A energia reativa indutiva é faturada nos períodos fora de vazio (cheia e ponta) sempre que o consumo de energia reativa seja superior a 30% do consumo de energia ativa, em integrações diárias.



A compensação do fator de potência não é necessária, ou está já a ser feita.

Dica de eficiência energética

O custo de aquisição e manutenção de um motor elétrico é desprezável quando comparado com o custo da energia consumida ao longo da sua vida útil; na generalidade dos casos, a energia consumida representa mais de 95% do custo global do motor. A substituição de um motor convencional por um motor de alta eficiência (classe IE3/IE4) é economicamente viável na maioria dos casos: o investimento é amortizado entre 1 a 3 anos, para regimes de funcionamento de 2000 a 4000 horas por ano. A substituição de motores é também uma boa oportunidade para corrigir sobredimensionamentos.

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

kisense ENERGY OPTIMISER

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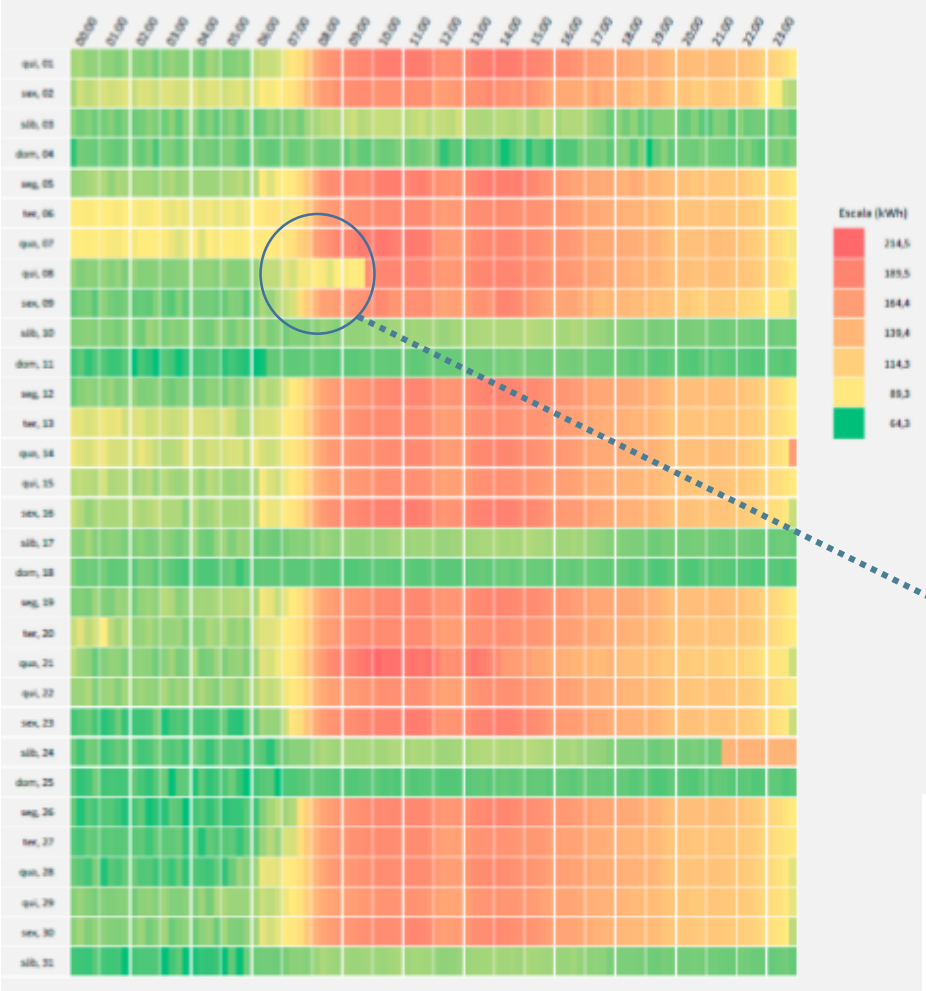
Heat Map



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.

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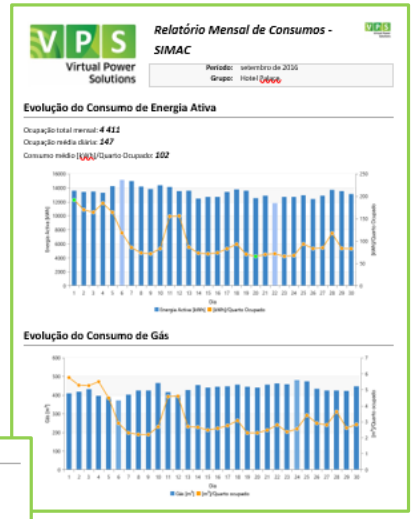
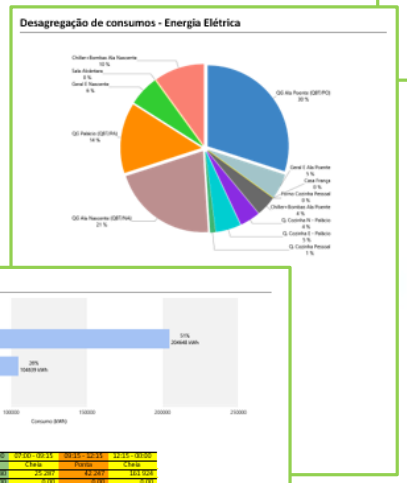
Energy Management Service

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

Definition of Energy regulations, according to consumption profiles

Energy costs reduction

Central management of all facilities

Greater efficiency in management of maintenance equipment, and consequent increase of its lifetime

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

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Connected Energy Networks

Manage Virtual Power Plants and Flexibility Pools

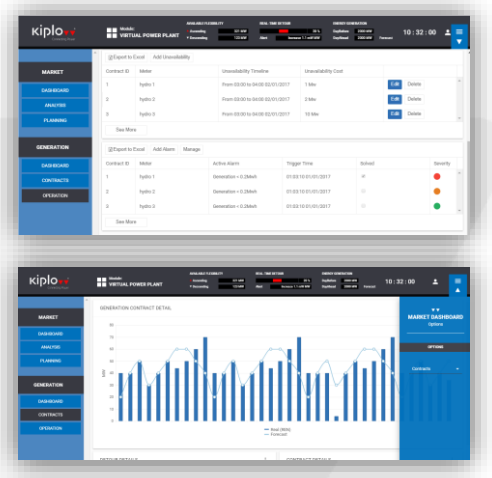
deploy Energy Communities

kiplo™

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

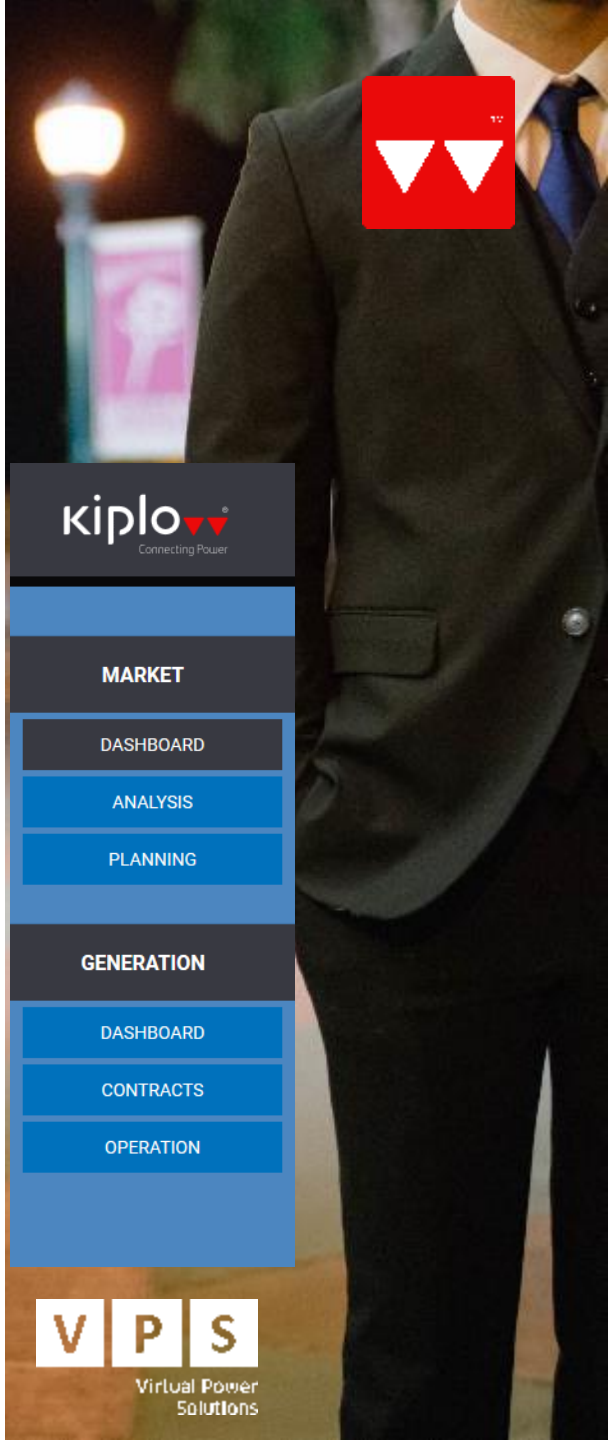
Tools to create value for retailer and aggregator

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

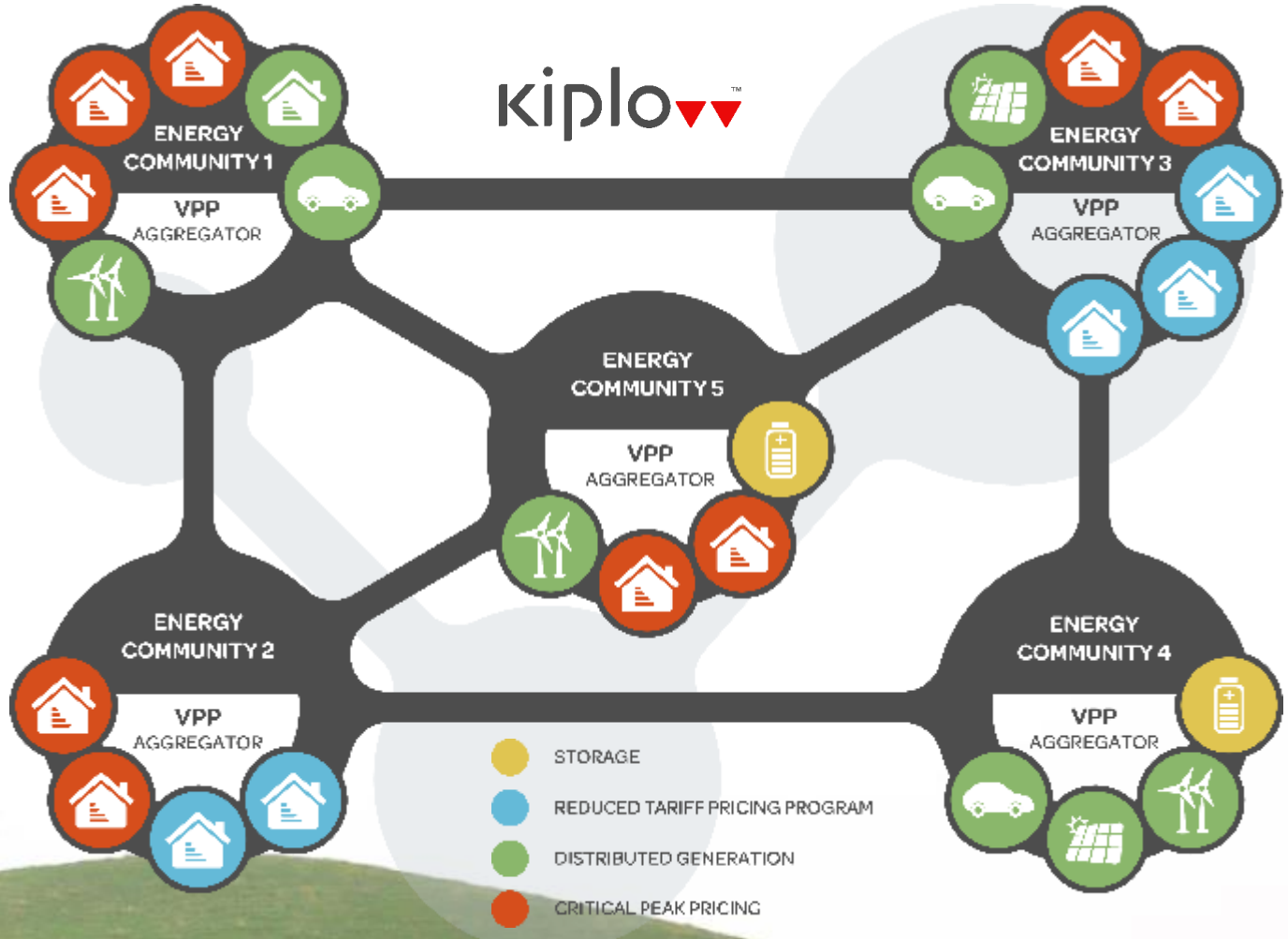
- Participate in balancing and ancillary services markets
- Participate in demand side response programmes
- Improve retail margins
- Minimise imbalance settlements
- Optimise distributed energy flexibility



Create new value for your customer

Create new offers with Energy Communities

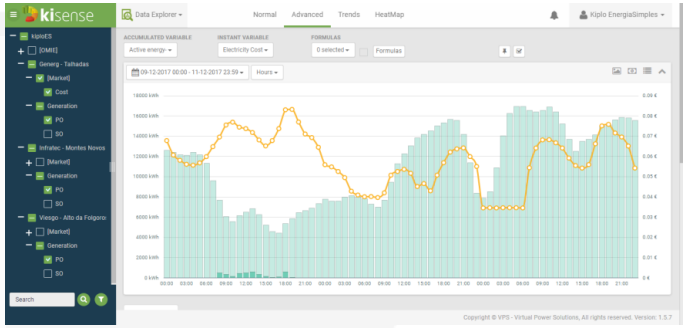
- Set **new tariffs** for the community members
- The community can benefit together from **cheaper energy prices**
- The community can benefit together from **distributed flexibility optimisation** (loads, storage, EVs,…)
- Member can **share local energy** production and benefit from reduced transmission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

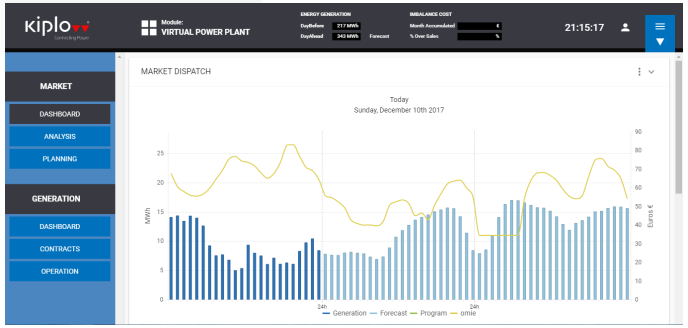


Retailer and aggregator

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



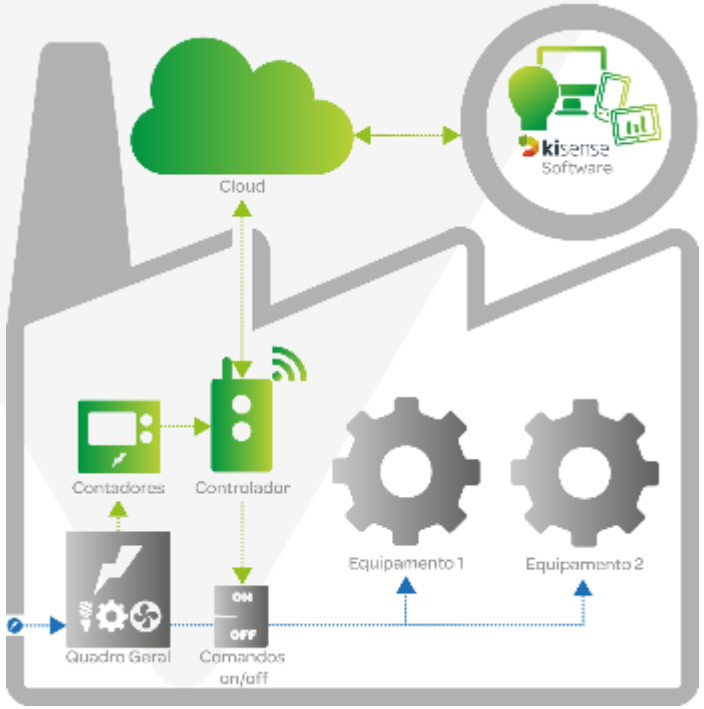


Virtual Power Solutions

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

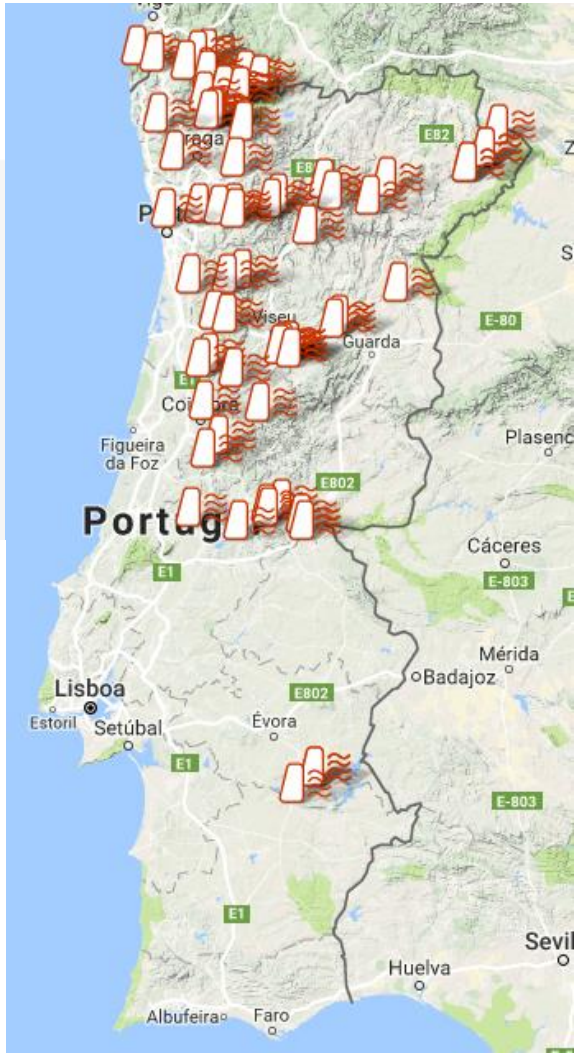


Virtual Power Solutions

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



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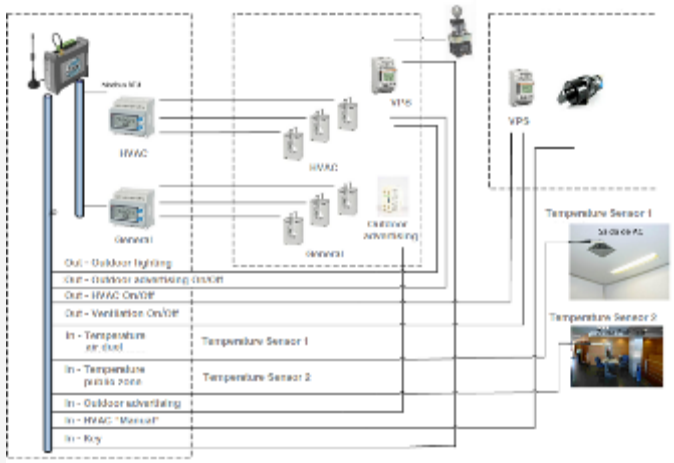
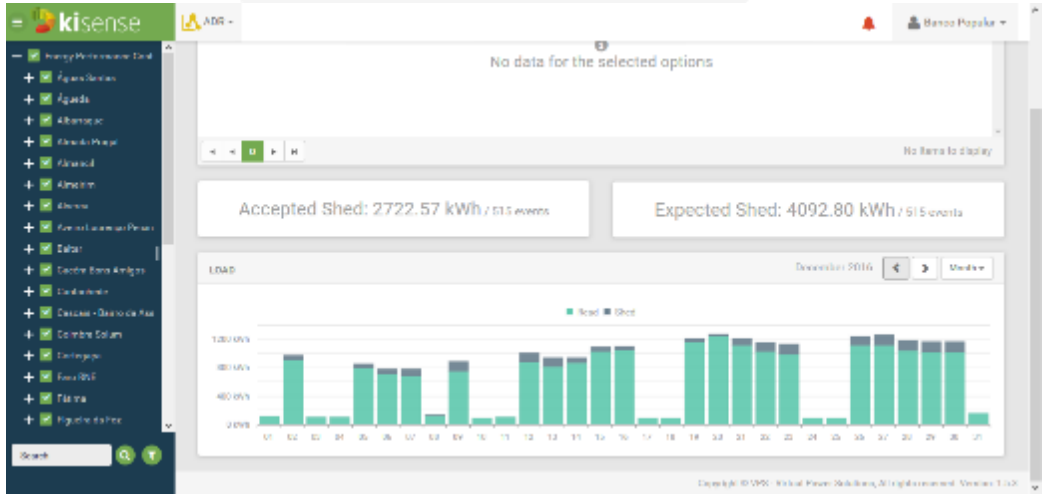
Energy Performance Contract

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%

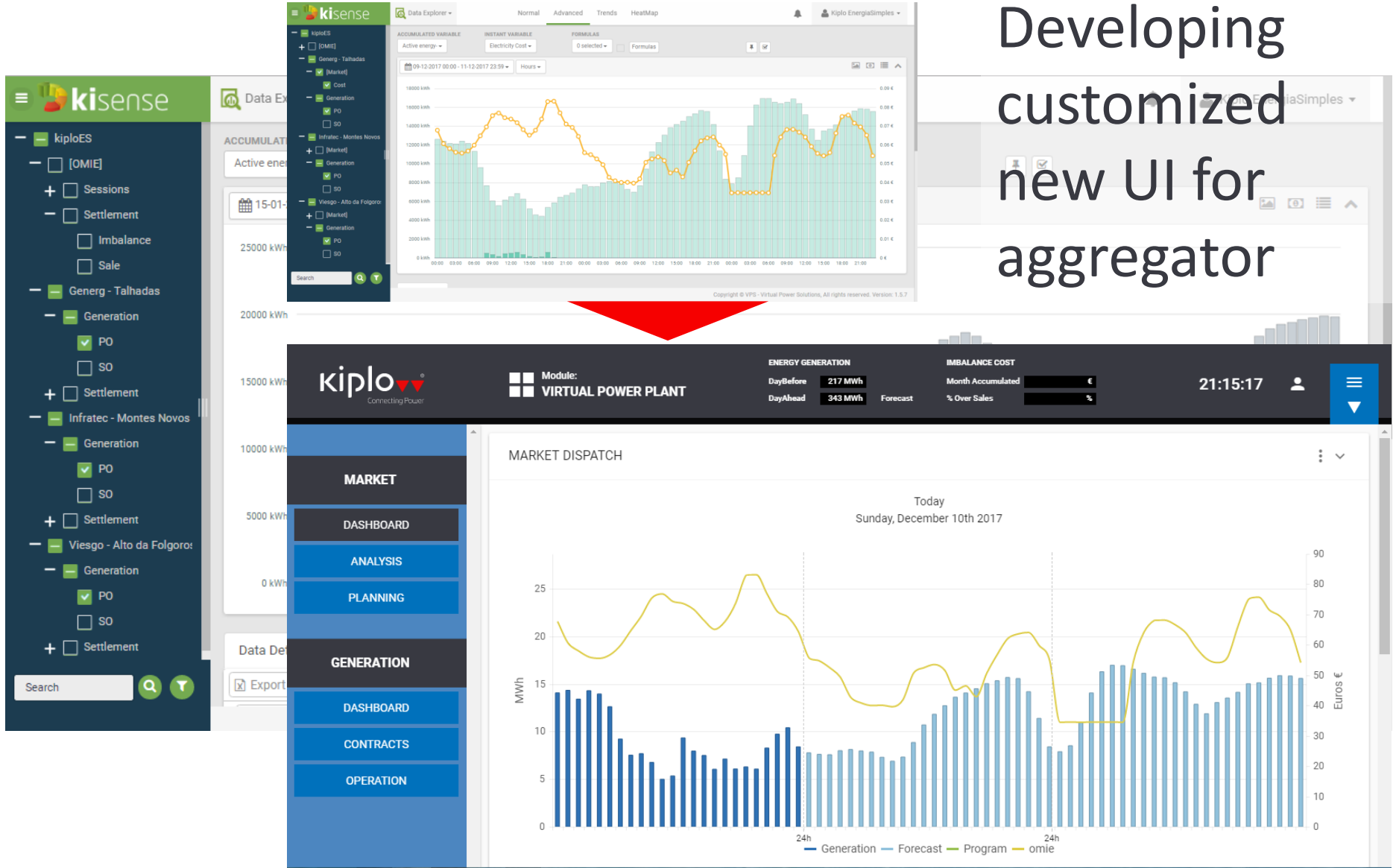




Virtual Power Solutions

Energy Community Platform

Data collection and aggregation to enable VPP



Developing customized new UI for aggregator

Pilotos

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Vila Real

- 30 munícipes

Alfândega da Fé

- 45 munícipes

Penela

- 32 munícipes

- Piscinas Municipais Cobertas
- Pavilhão de Desportos
- Centro Escolar das Árvores
- Museu da Vila Velha

- Casa da Cultura (UPAC)
- Biblioteca Municipal (UPP)
- Mercado Municipal (UPAC)
- Paços do Concelho

- Biblioteca e Auditório (UPAC)
- Centro Escolar de Penela
- Centro Escolar Espinhal
- Pavilhão Multiusos

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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

Mercado Municipal	BTN
Biblioteca Municipal	BTN
Paços do Concelho	BTE
Casa da Cultura	BTE

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

Cenários e casos de uso

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 publica, 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%

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Technology

Linking homes with low cost HEMS

Cloogy

Mobility

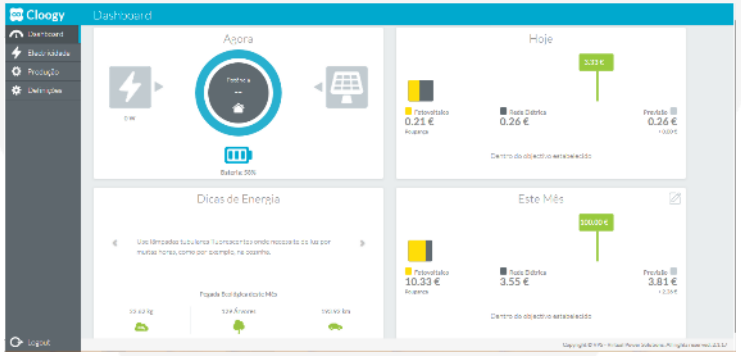
Real Time

UX Inclusive Design

Remote Control

Plug&Play

Interoperability



Plataformas do utilizador final

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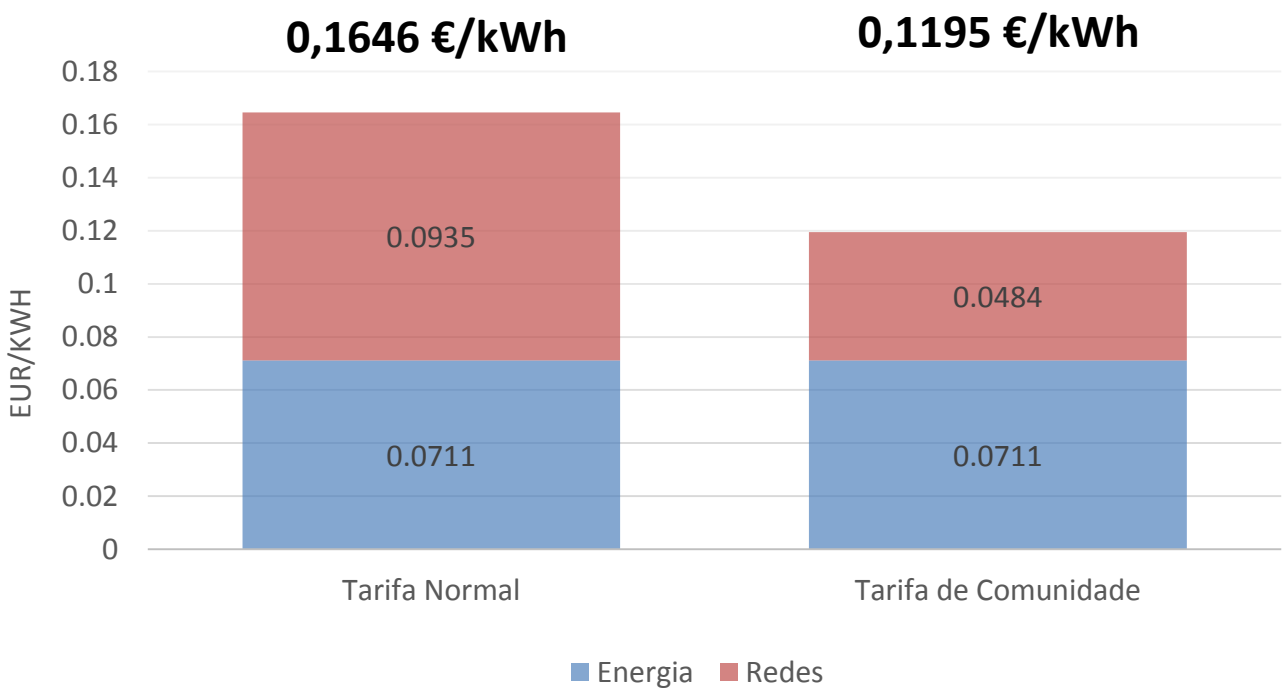
Partilha de energia



- 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)

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Conclusão

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- 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

Key Results

VPP at the company level with 120 branches

Popular

Minimise *Energy Efficiency*	Energy consumption Eliminate 'wasted' energy	up to 15%
Optimise *Load Management*	Energy resources Renewables & Storage	Additional 7%
Monetise *Demand Response*	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)

Additional 34%

Current and planned developments

Interaction with National Grid DSR schemes

Integration with Batteries

Machine learning

Create new value for utilities

Create new offers with Energy Communities

- Set **new tariffs** for the community members
- The community can benefit together from **cheaper energy prices**
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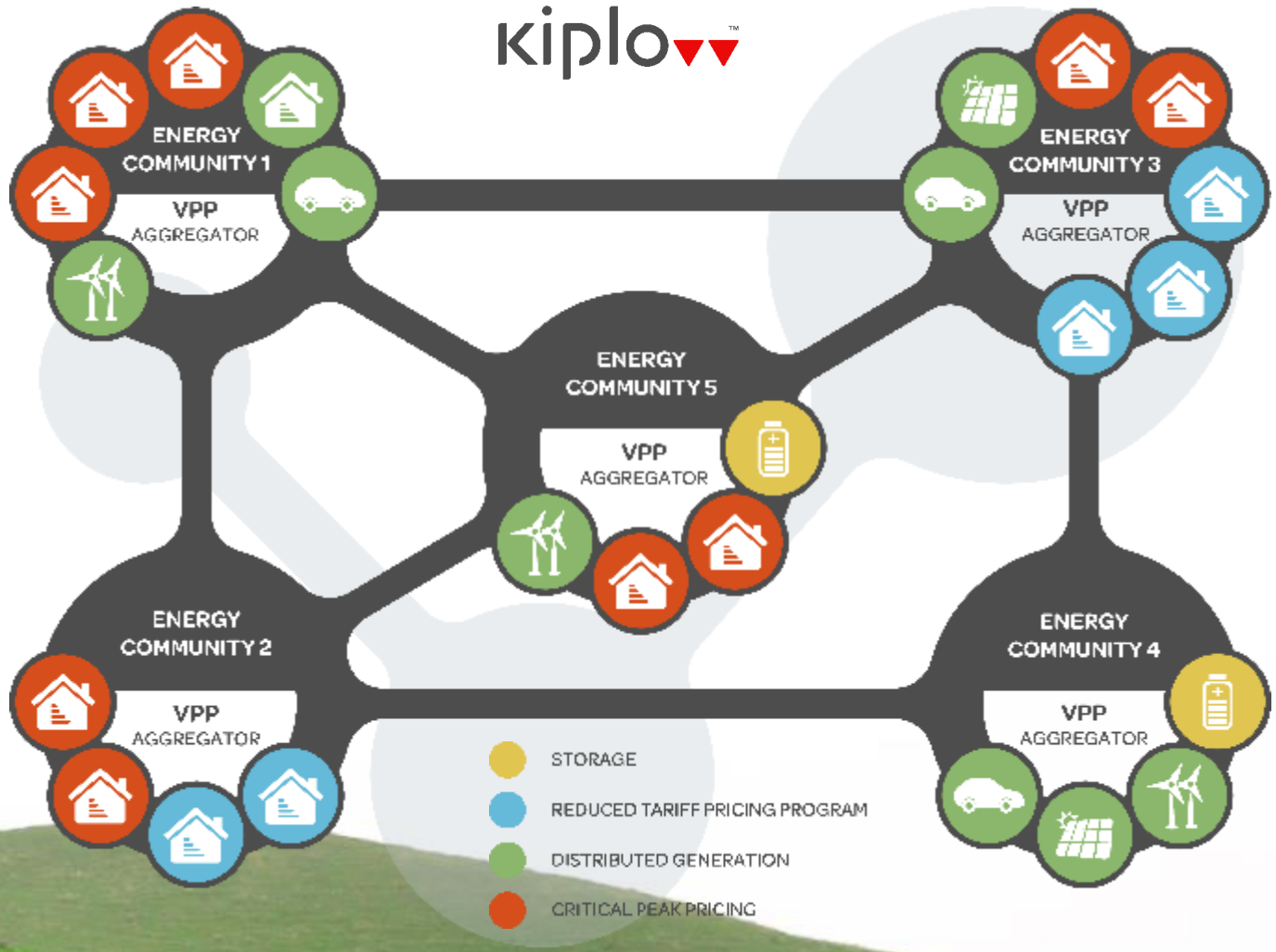

Energy Communities & VPP platform

kiplo™

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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

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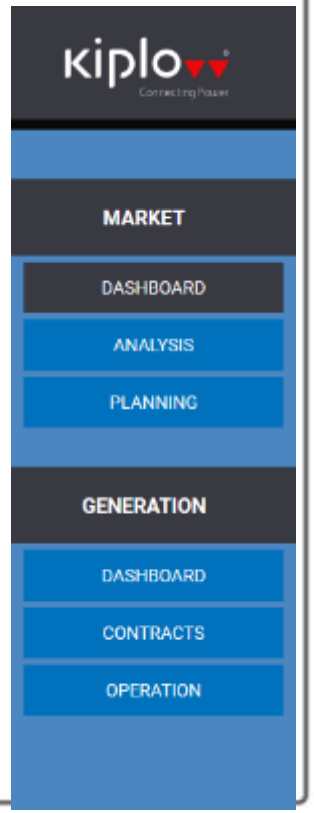
Virtual Power plant manager

- 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 DSR programmes
- Improve retail margins
- Minimise imbalance settlements
- Optimise distributed energy flexibility



Data collection and aggregation to enable VPP

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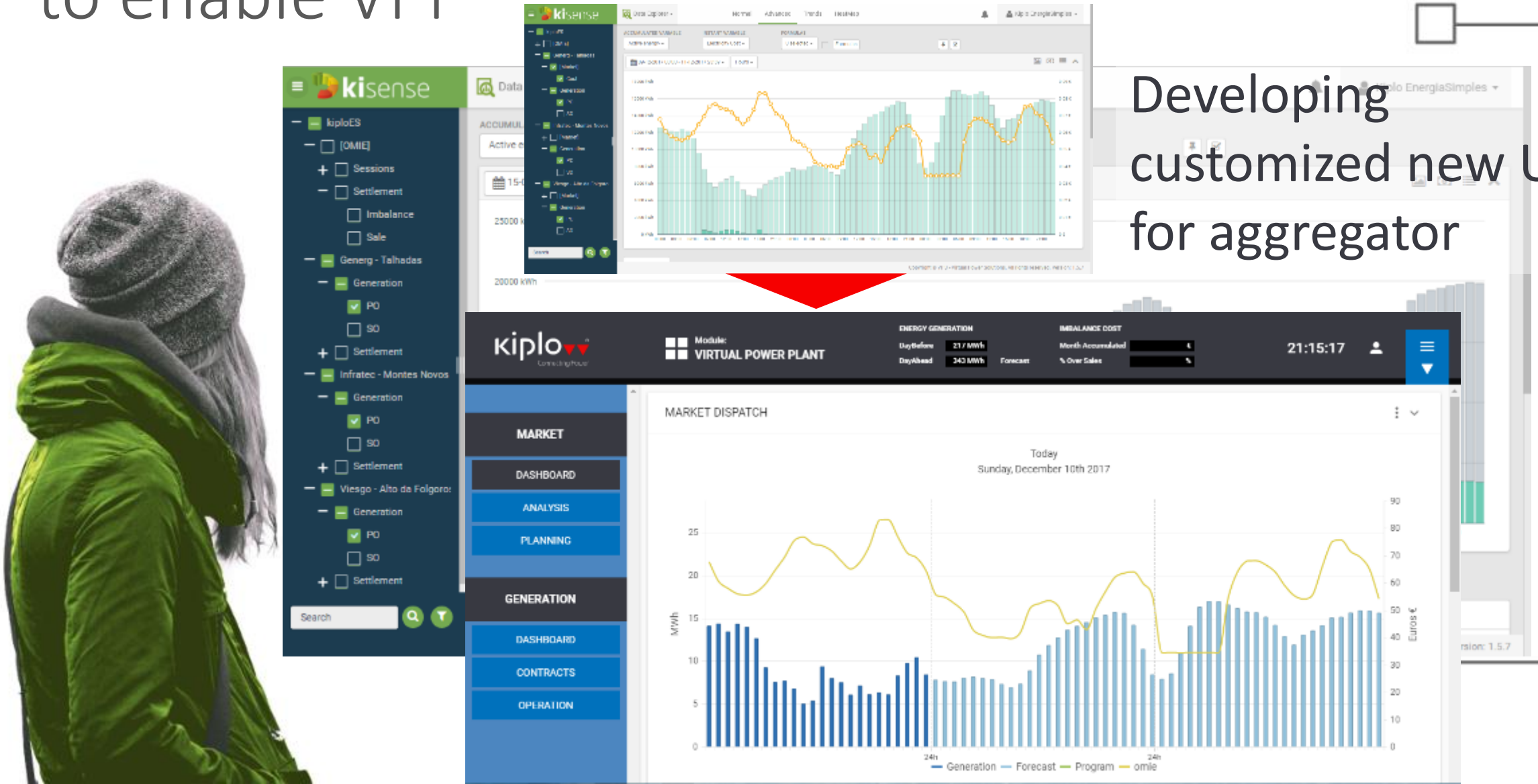


Developing customized new UI for aggregator

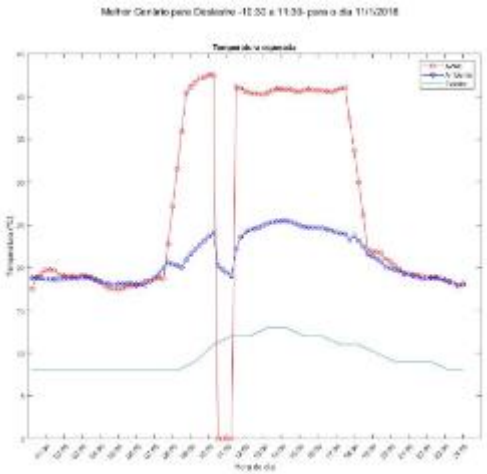
Integration with Batteries

- ✓ 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

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New challenges ahead?

The transactive grid & Blockchain

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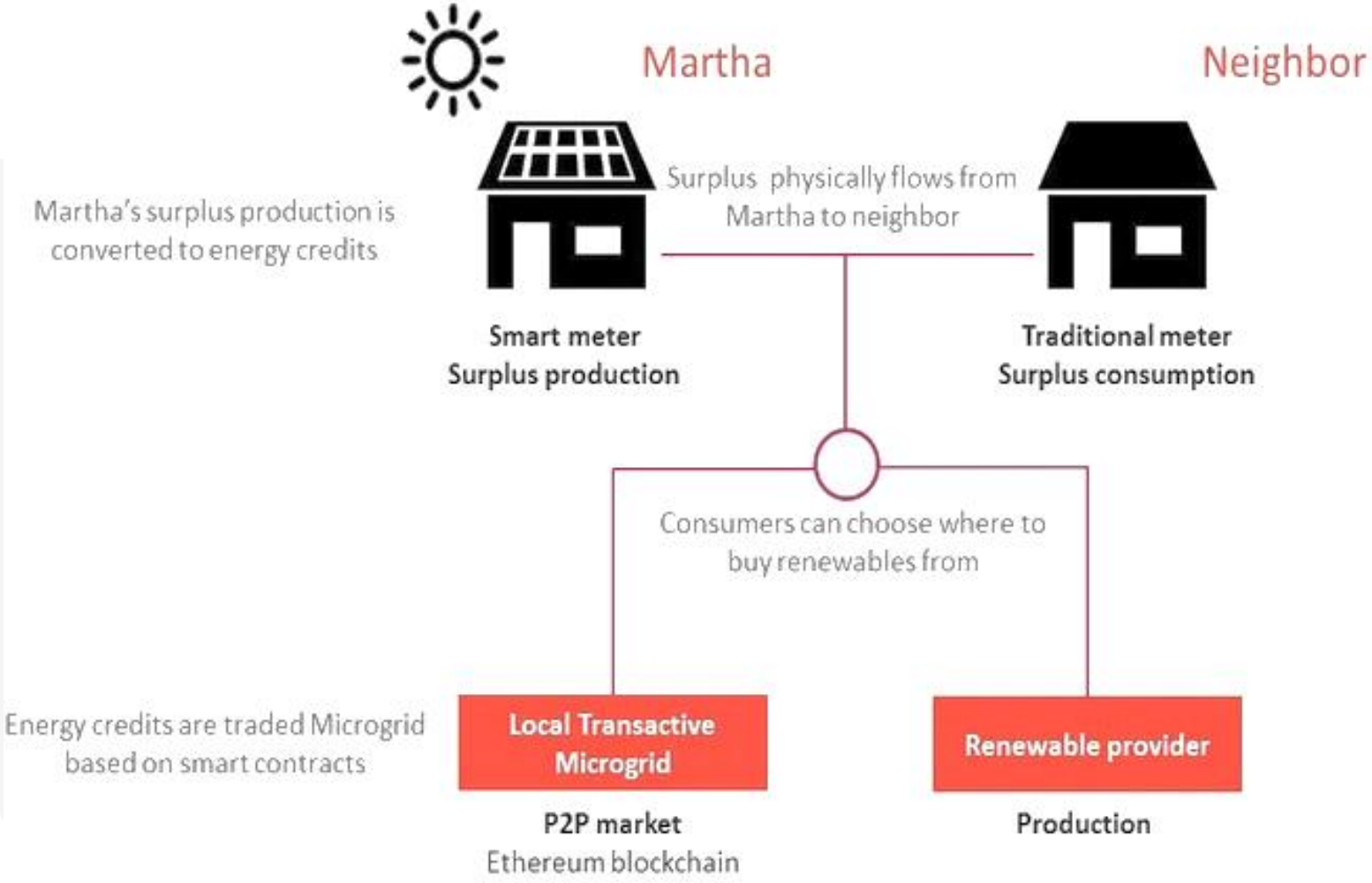
Energy blockchain

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

Universidade de Coimbra
isep Instituto Superior de Engenharia do Porto
IPN Instituto Pedro Nunes
Institute of Systems and Robotics University of Coimbra
universidade de aveiro
Universidade do Minho
U.PORTO
INESCPORTO
Fraunhofer Portugal
Fraunhofer IGB
Fraunhofer IDMT
Fraunhofer FIT
Fraunhofer ISE
Catolica Lisbon
Universidade Beira Interior
Centre for Research and Technology - Hellas Informatics & Telematics Institute
Heriot Watt University
instituto de telecomunicações
Luleå Tekniska Universitet
CeTIM
Técnico Lisboa
Örebro Universitet
Lunds Universitet
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Cardiff University Prifysgol Caerdydd
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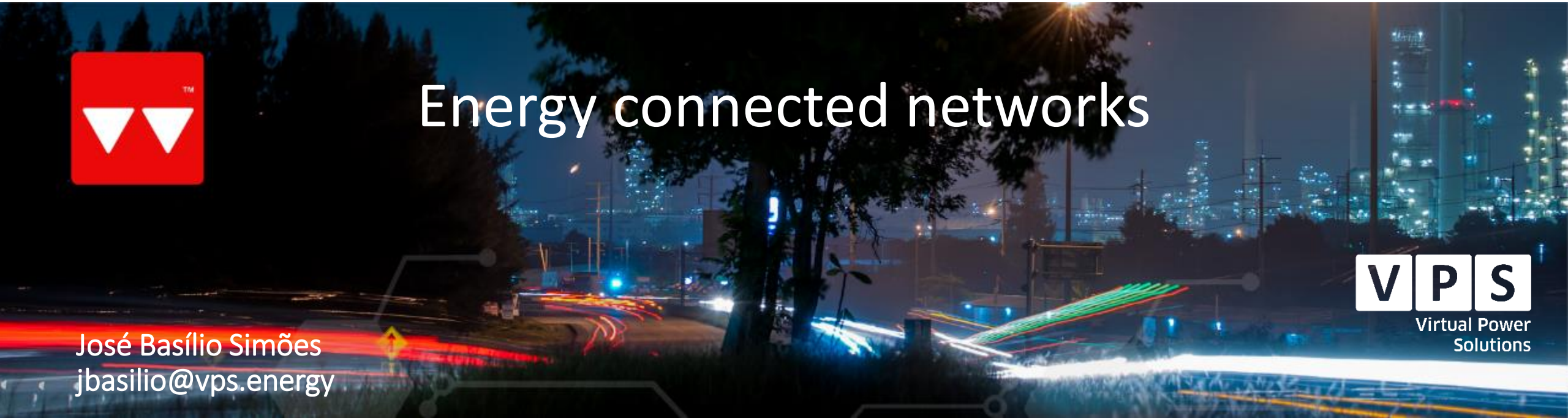
University of Salford Manchester
TU Delft Delft University of Technology
AIT Austrian Institute of Technology Tomorrow Today
Consiglio Nazionale delle Ricerche
Uma Universidad de Málaga
Yasar Üniversitesi
Universidad de Navarra
ITI Instituto Tecnológico de Informática
University of Oulu
tecnalia Inspiring Business
Mälardalen University Sweden
vito vision on technology
XLAB Not Idle
NTUST

Thank you



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