



Una universidad
innovadora y sostenible
con Acreditación Institucional

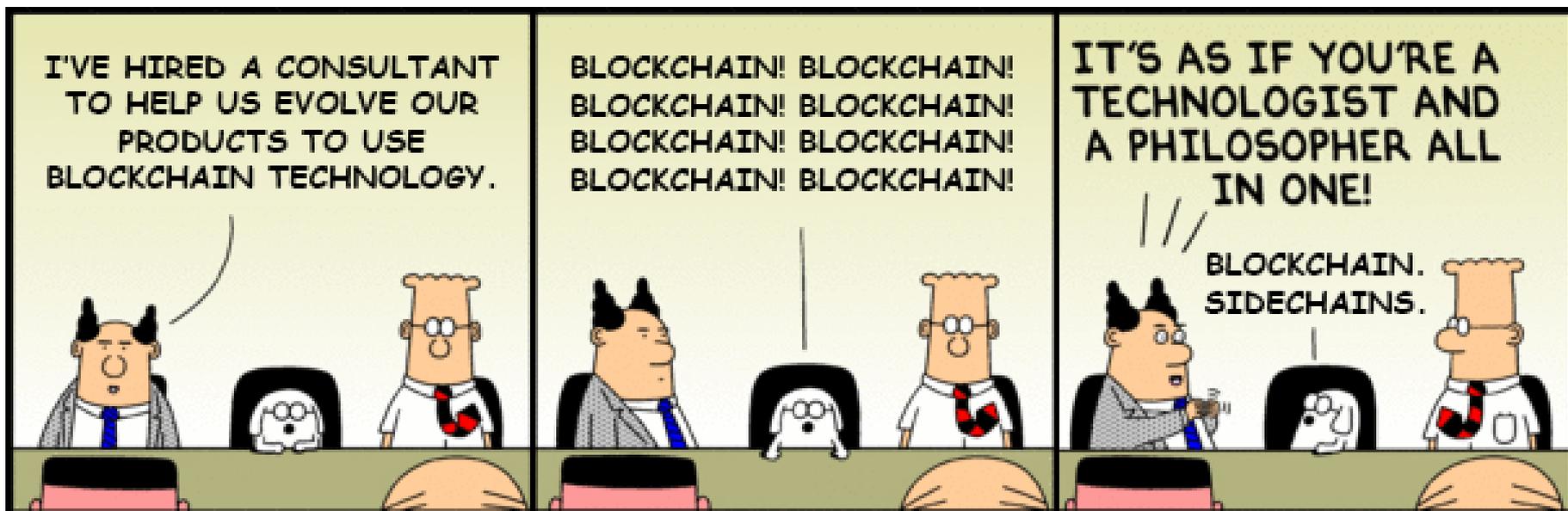
Juan Manuel España
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Investigador @EnergEIA
Biz Dev Latam @ME SOLshare

I'VE HIRED A CONSULTANT
TO HELP US EVOLVE OUR
PRODUCTS TO USE
BLOCKCHAIN TECHNOLOGY.

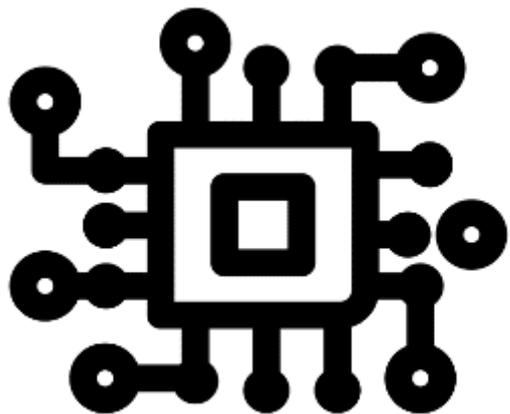
BLOCKCHAIN! BLOCKCHAIN!
BLOCKCHAIN! BLOCKCHAIN!
BLOCKCHAIN! BLOCKCHAIN!
BLOCKCHAIN! BLOCKCHAIN!

IT'S AS IF YOU'RE A
TECHNOLOGIST AND
A PHILOSOPHER ALL
IN ONE!

BLOCKCHAIN.
SIDECHAINS.



La Industria eléctrica está cambiando



Digitalización



Descentralización



Descarbonización

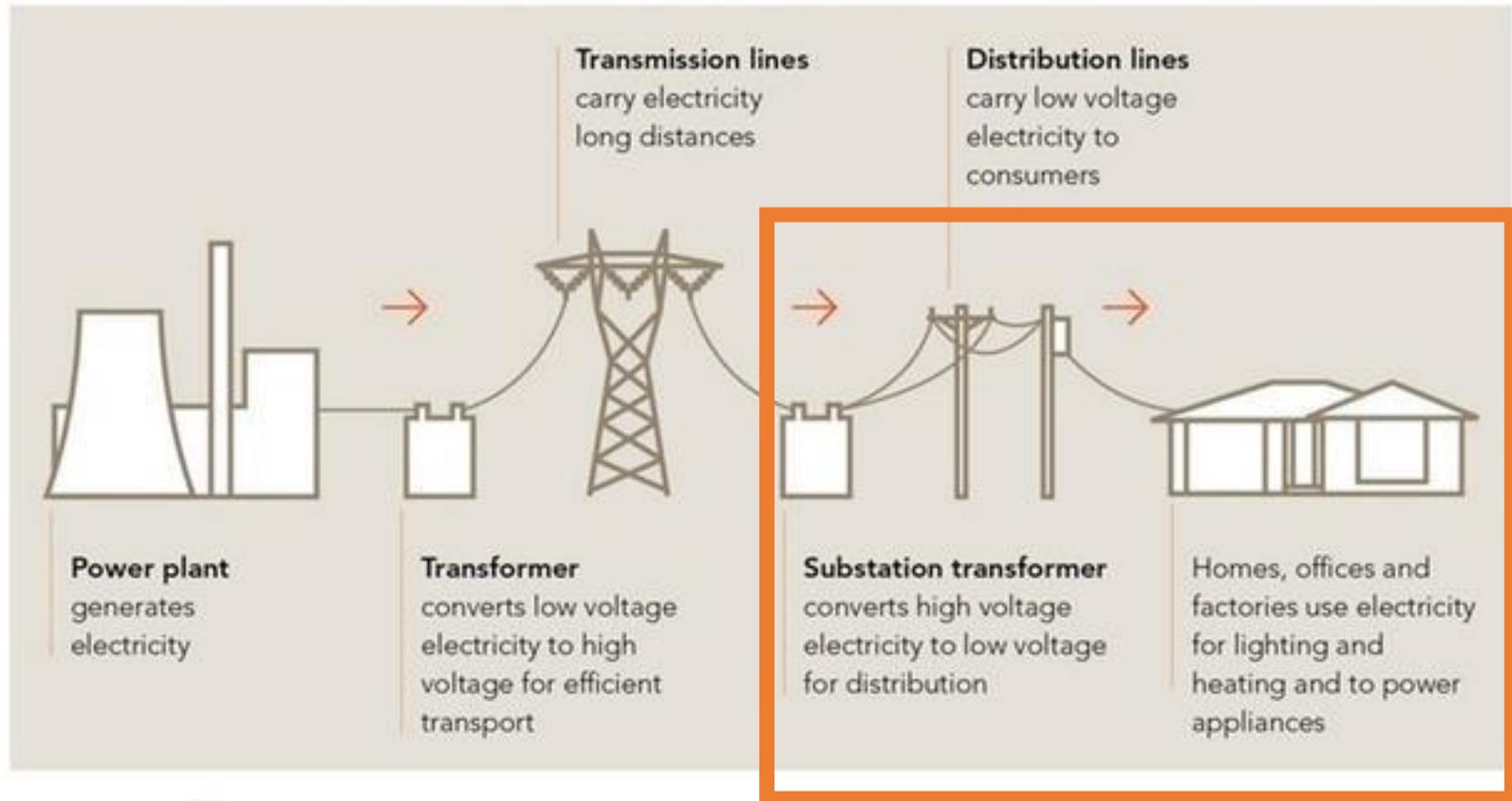


Democratización



Desregularización

El protagonismo de nuevos actores



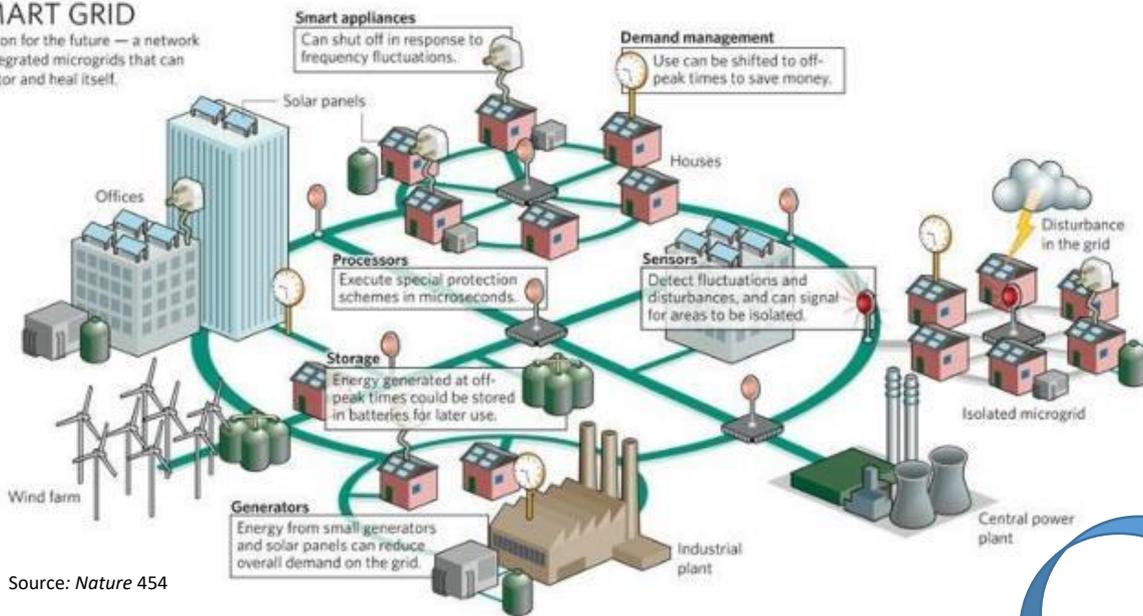
Market Realist

Source: Energy.gov

Nuevo panorama: prosumidores

SMART GRID

A vision for the future — a network of integrated microgrids that can monitor and heal itself.



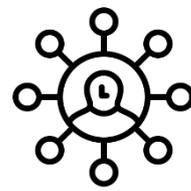
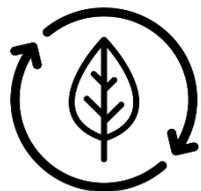
Source: Nature 454

Comportamiento según preferencias

Buscan maximizar su **función de utilidad**

Decisiones en tiempo real (o casi)

transparencia, simplicidad y conveniencia

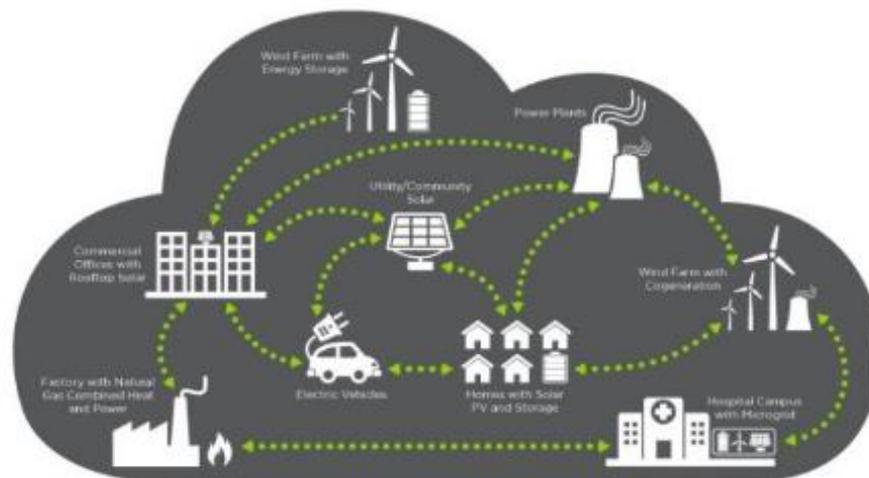


Agentes transaccionales de **energía**

Energía Transaccional – *Transactive Energy*

“Sistema de **mecanismos económicos y de control** que permiten el balance dinámico de la oferta y la demanda en toda la infraestructura eléctrica usando el valor como parámetro operacional clave” -
The Transactive Energy Framework – GridWise Architecture Council

EMERGING: THE ENERGY CLOUD



Fuente: Navigant Consulting

Energía Transaccional

“Sistema de **mecanismos económicos y de control...**”

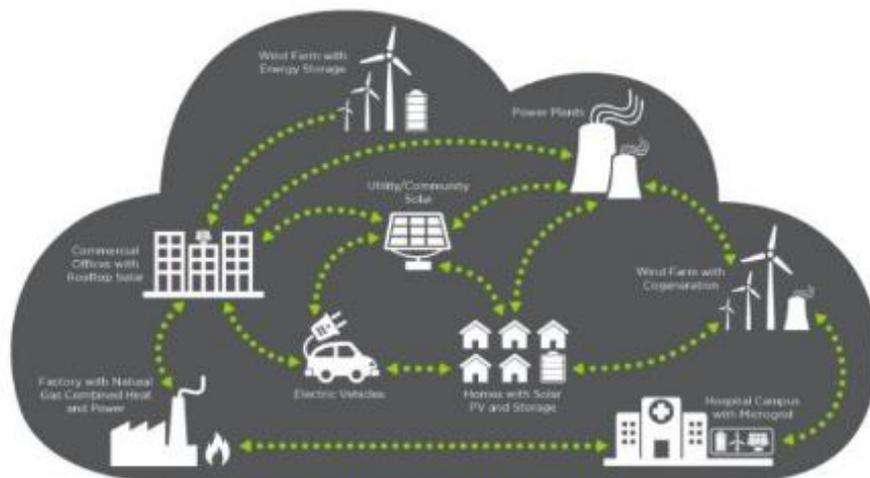


Contratos inteligentes



TOKENIZACIÓN

EMERGING: THE ENERGY CLOUD



Fuente: Navigant Consulting

Tokenización de *Transactive Energy*

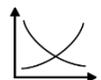
Energía



1 kWh de energía **generada**



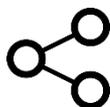
1 kWh de energía **ahorrada**



1 kWh de energía **desplazada**



1 kWh de energía **almacenada**



1 kWh de energía **compartida**

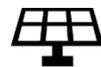


1 kWh de energía **donada**

Servicios



Confiabilidad



Capacidad



Disponibilidad



Control V,f



Reconfiguración

Activos



Empresas



Proyectos de energía

Tipos de Tokens

Token de valor financiero (*security token*):

Una empresa crea un token similar a **acciones o bonos**

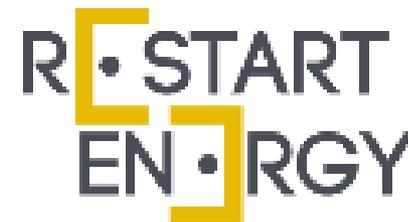
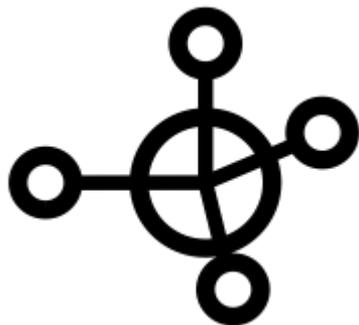


Su valor está ligado al éxito de la empresa que emite los tokens y no al uso



Tokens utilitarios (*utility token*):

Se crea con el propósito de **facilitar el acceso a la plataforma**



Security Tokens de energía



envion

Off-Grid Blockchain Mining

\$100M recaudados

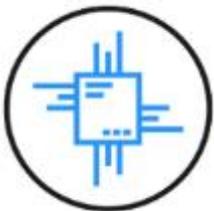


Utility Tokens

La representación de la **utilidad de la red**

La innovación es de **incentivos programables** creados y aplicados mediante contratos inteligentes

El **valor de la innovación** se refleja en su aplicación con diferentes capas, actores e incentivos



Pero la utilidad/valor digital es difícil de estimar!

Diseñando un *token utilitario* de energía

El usuario en el centro del modelo de negocio

Perfil de incentivos de los **¡no es sólo precio!**

Incentivar y monetizar el **efecto de red**

Experiencia de **usuario**

Modelos que faciliten la **inclusión y eviten la marginalización**

Interoperabilidad con sistemas energéticos actuales

Distribuir tokens



Diseñando un *token utilitario* de energía



¡Utilitywashing!

Distribución de Tokens

Initial Coin Offering - ICO

En un ICO, una empresa emite Tokens (Coins) con el fin de **recaudar capital de manera masiva** para traer a la realidad un **modelo de negocio** (basado en Blockchain)



Estos tokens pueden ser

- **Tranzados** en bolsas digitales de cripto
- Como **medio de pago** digital
- Como **medio de acceso** a productos, servicios y plataformas de la empresa



ICO como innovación financiera

coindesk

All-Time Cumulative ICO Funding



ICOs en el sector eléctrico



Power Ledger (POWER)



WePower (WPR)



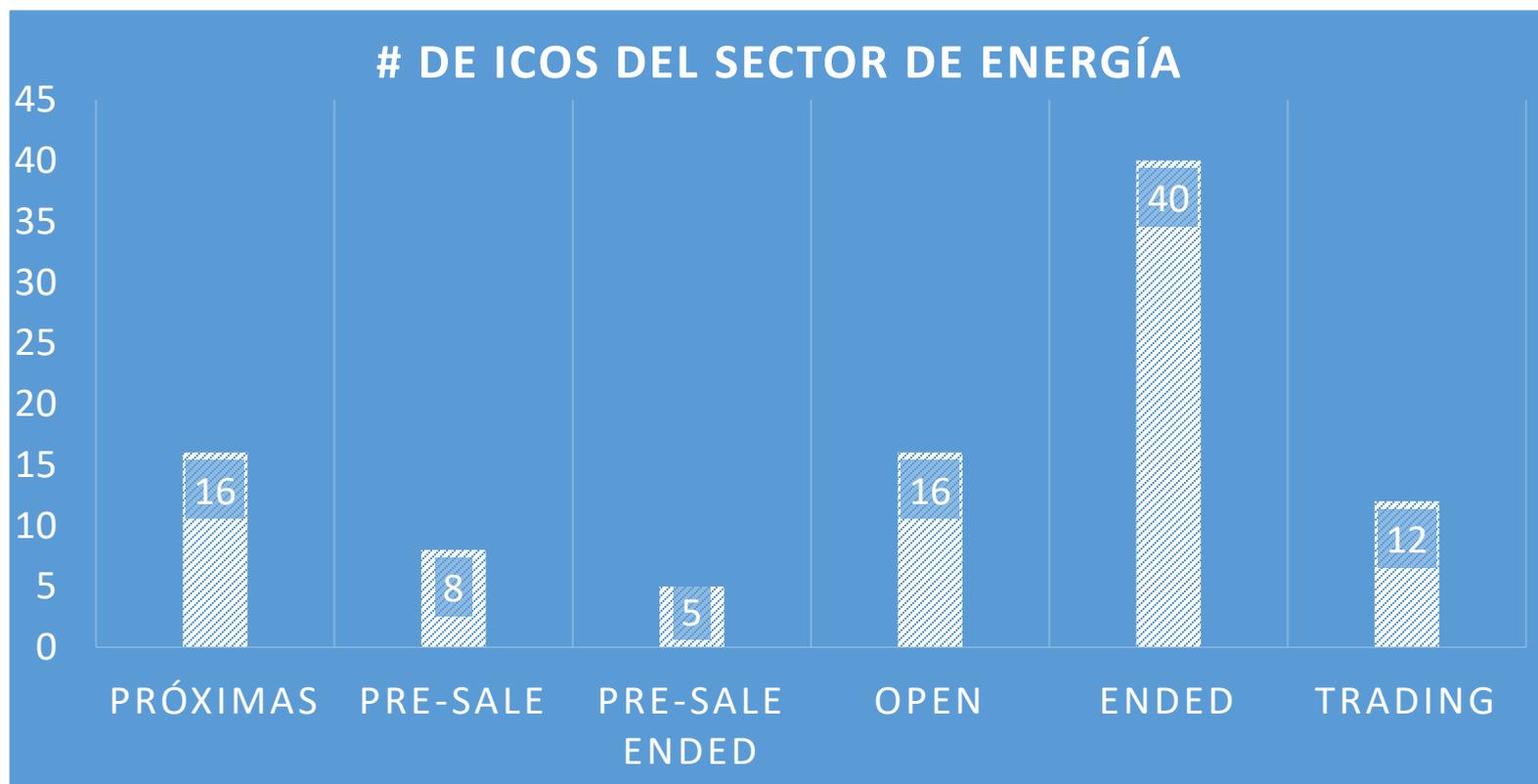
Grid+ (GRID)



Pylon Network (PYLNT)

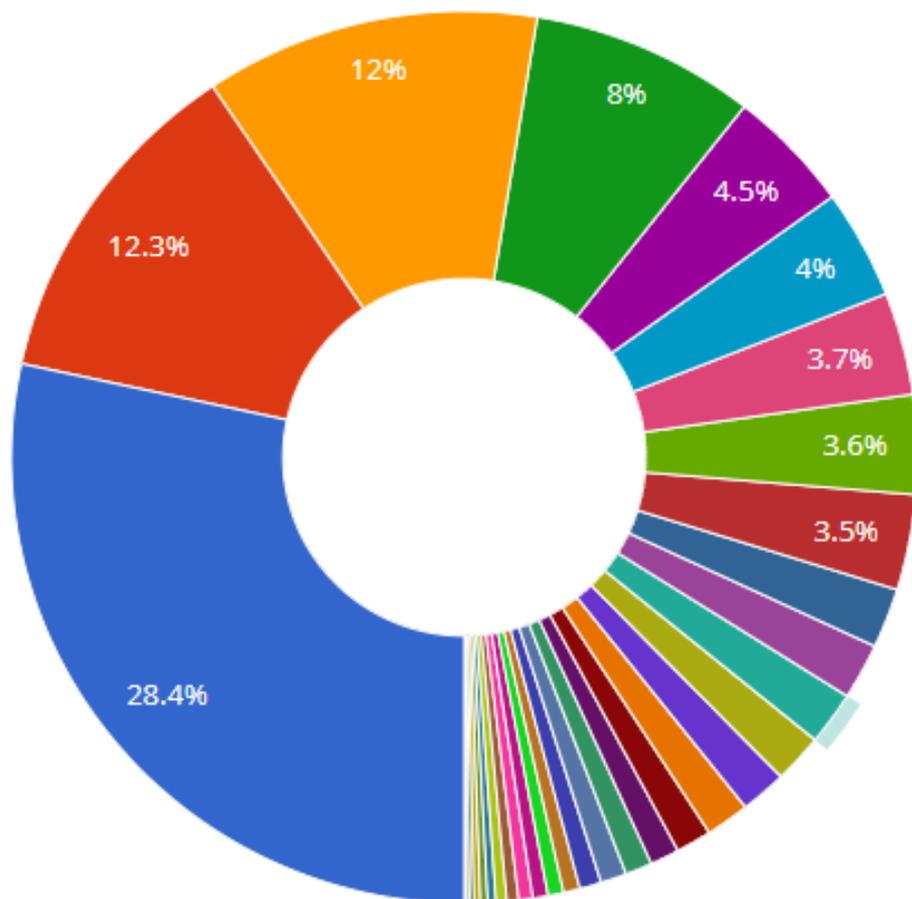


SunContract (SNC)



Relevancia para el sector eléctrico

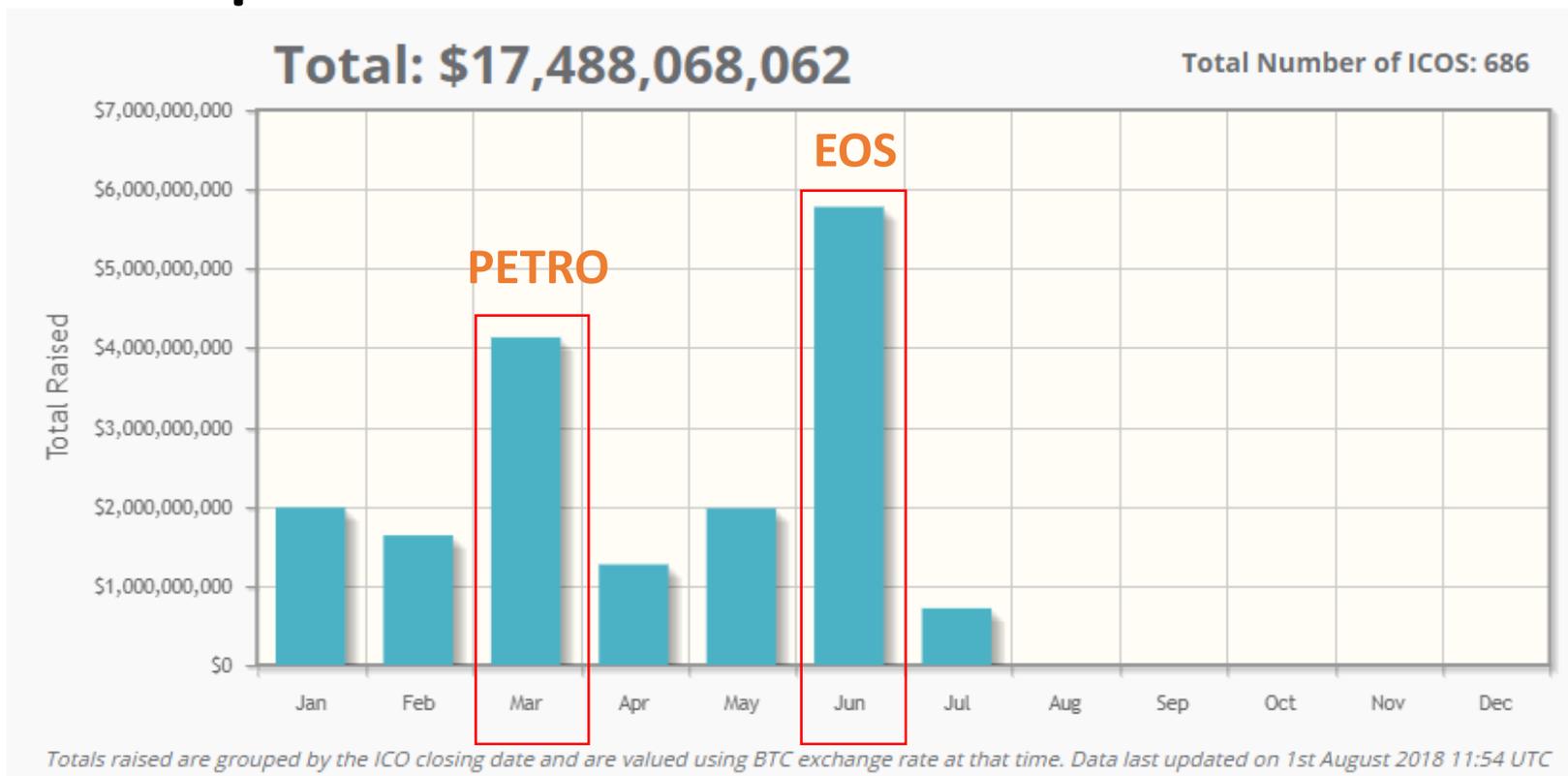
ICOs by Category 2018



- Infrastructure 28.4% (\$4,853,733,669)
- Finance 12.3% (\$2,096,716,847)
- Communications 12.0% (\$2,045,927,475)
- Trading & Investing 8.0% (\$1,374,070,108)
- Governance 4.5% (\$765,000,000)
- Pa 28)
- Ga 0,873)
- Ev % (\$614,536,575)
- Co 5% (\$591,522,394)
- M 3,083)
- Supply & Logistics 2.0% (\$346,692,493)
- Machine Learning & AI 1.9% (\$329,531,628)
- Energy & Utilities 1.8% (\$304,061,843)
- Social Network 1.7% (\$283,212,500)
- Privacy & Security 1.6% (\$267,802,378)
- Gambling & Betting 1.3% (\$217,793,905)
- Mining 1.0% (\$178,353,454)
- Data Storage 1.0% (\$164,922,311)

Menos del 2%

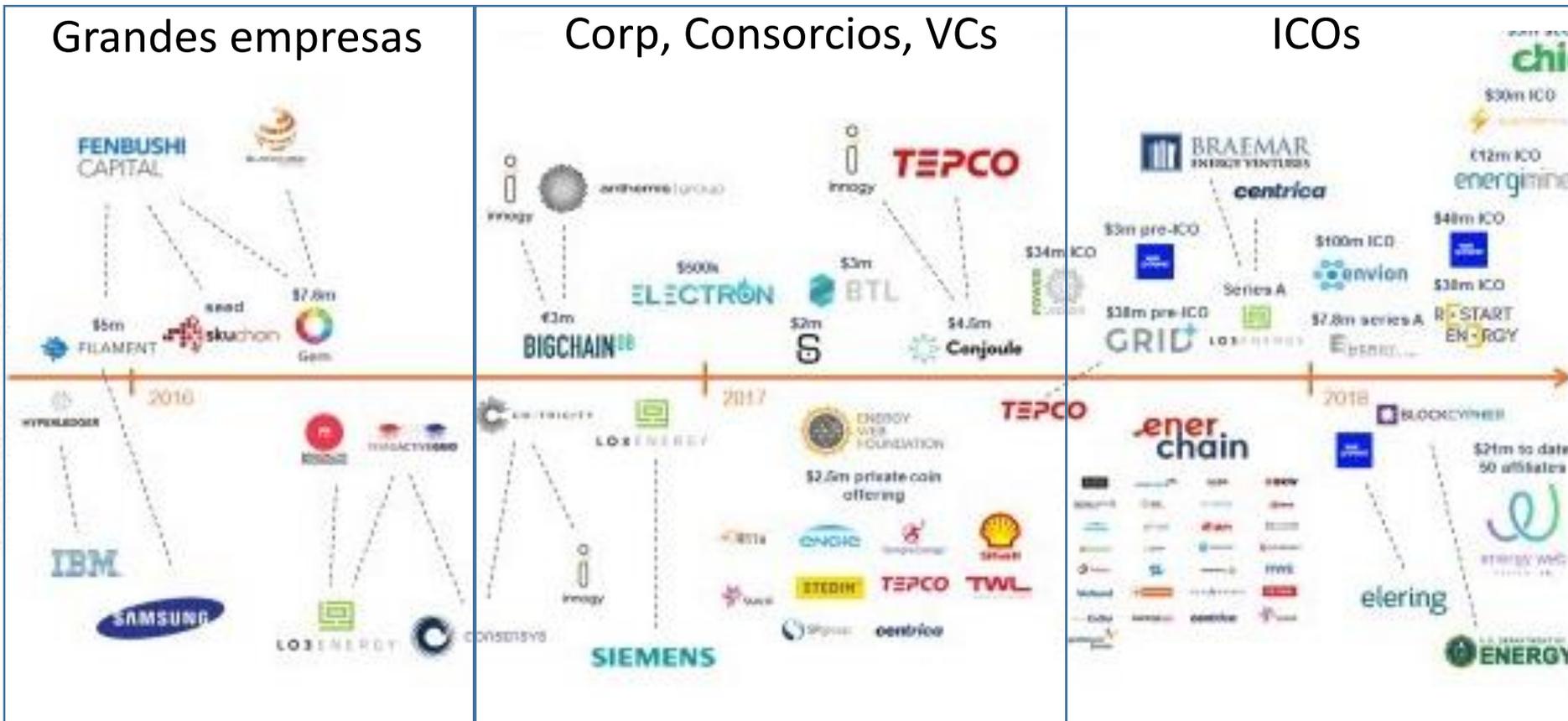
Comportamiento de ICOs en 2018



- Hay una tendencia de desaceleración
- Hay más proyectos listados, pero su precio es menor
- La calidad promedio de los proyectos ha aumentado
- El porcentaje de proyectos que sobreviven es menor



ICOs + VC: financiando la transición



Aplicaciones de tokens de energía

Transacciones

**MEM
(24%)**



Fuente: <http://nyssmartgrid.com/nyiso-control-center/>

Financiamiento (12%)



Fuente: energy.gov

P2P (36%)

Movilidad (11%)



Fuente: <http://topherdonahue.com/>



Fuente: propia

Sostenibilidad (11%)



Fuente: <https://p2pconnecting.com/about/>

Livingston, D., Sivaram, V., Freeman, M. and Fiege, M.. July 2018. Applying Blockchain Technology to Electric Power Systems - Discussion paper

Auctions

Expected energy in Donation pool **5670 MWh**



Badajoz 50MW Section 1
at Extremadura, Spain

Solar energy

Expected donation: **945MWh**
Auctioned energy: **105000MWh**



Badajoz 50MW Section 2
at Extremadura, Spain

Solar energy

Expected donation: **945MWh**
Auctioned energy: **105000MWh**



Badajoz 50MW Section 3
at Extremadura, Spain

Solar energy

Expected donation: **945MWh**
Auctioned energy: **105000MWh**



Solar irradiation

© 2017 The World Bank, Solar resource data: Solargis



Badajoz 50MW Section 1

Solar energy
0.04 €/kWh

Estimated auctioned energy
105000 MWh

Investment: 1000 €
Yearly consumption: 5000 kWh

Bid price per kWh: 0.040 €/kWh
Total purchase: 25 MWh

5 Y
€1,225.00
23%

I'M INTERESTED

Initial review completed: March '18
Preliminary engineering started: **April '18**
Construction permission: September '18
Due diligence finalized: September '18
Financial closing: October '18
Energy auction: October '18



Project description

Extremadura,

GRID+



Grid+ Agent

Your smart agent helps buy and sell electricity, at the cheapest rates, on your behalf.



Grid+ App

Our simple app lets you view usage, make payments, and find ways to cut down on your energy usage.



Smart meter

We connect to your smart electric meter wirelessly and securely.

Metron

Energy Smart Metering based on Blockchain Technologies.

Metron One

Powered by Egeo



Metron Analyzer

Powered by Egeo

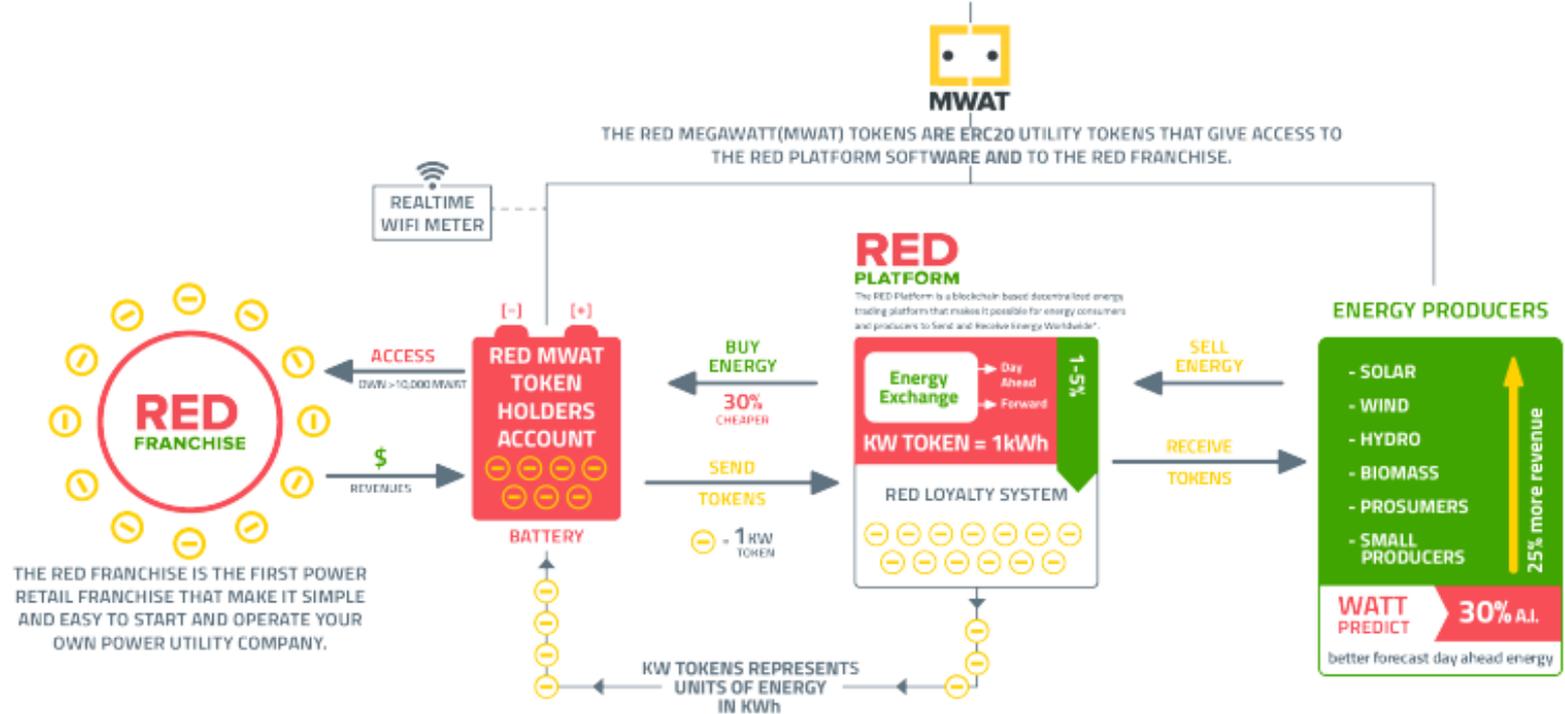


Metron Plus

Powered by Smappee

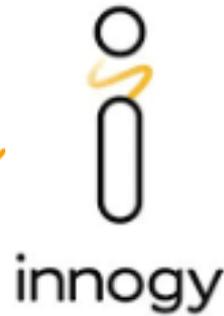


SEND AND RECEIVE ENERGY WORLDWIDE* USING MWAT TOKEN

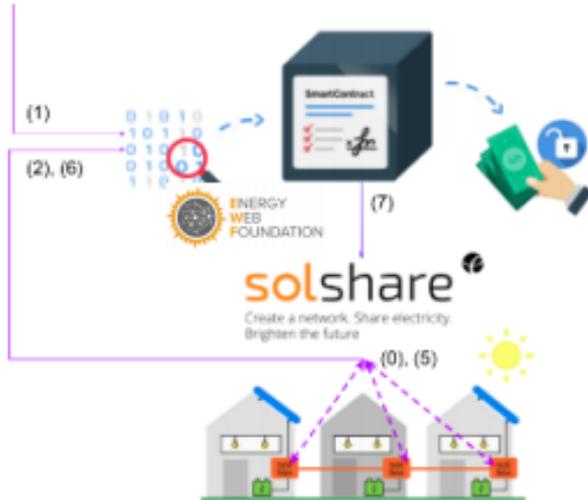


*The tokenized energy traded on the RED Platform can be physically delivered at local rates in countries with deregulated energy markets where Restart Energy will be present directly or through franchise.

freelio



solshare[®]
TEPCO



- For every solar PV bought in Germany, 1% will be donated in Bangladesh. Public donations can be integrated
- Anyone can commit a donation budget for supporting e.g. businesses in rural areas via Smart Contract
- SOLshare provides proof of eligibility, channels payments to smart meters in SHS
- All parties can view the current status of available, eligible, and allotted donations and uses

Hoy decimos que Blockchain es

- **Revolucionaria y disruptiva**
- **Creadora de una nueva economía digital**
- Con potencial de **transformar** nuestra sociedad
- Capaz de **facilitar la conectividad** entre las personas
- Que traerá **democratización de la información** y acabará con intermediarios



BLOCKCHAIN

“But in the mid 1990s, internet still had only minimal uses and yet, **anything.com**’s began popping up everywhere. **Putting “dot com” in your company name was enough to land you a golden ticket to IPO stardom; not to mention a few hundred million.**”

Fuente: Noam Levenson Writer, researcher, and investor in Distributed Ledger Technology — CEO and Co-founder of Eden Block. EdenBlock.com

2010s Blockchain

“But in the mid ~~1990s~~, ~~internet~~ still had only

Blockchains

minimal uses and yet, ~~anything.com~~’s began

Blockchain

popping up everywhere. Putting ~~“dot com”~~ in

your company name was enough to land you a

ICO

golden ticket to ~~IPO~~ stardom; not to mention a

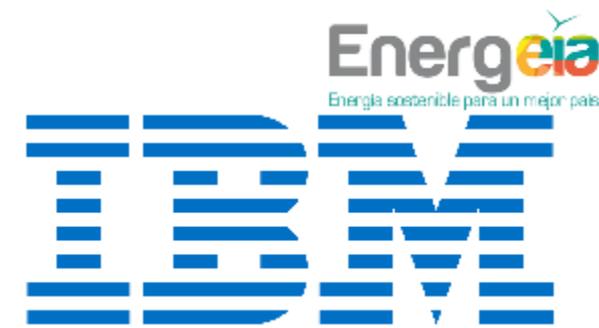
few hundred million.”

Fuente: Noam Levenson Writer, researcher, and investor in Distributed Ledger Technology — CEO and Co-founder of Eden Block. EdenBlock.com

European Parliament passes a blockchain resolution

May 18, 2018

Members of the European Parliament passed a blockchain resolution by the Industry, Research and Energy Committee on Wednesday (16 May)



blockchain.mit.edu

HOME RESEARCH ARTICLES LIVE BLOCKCHAIN

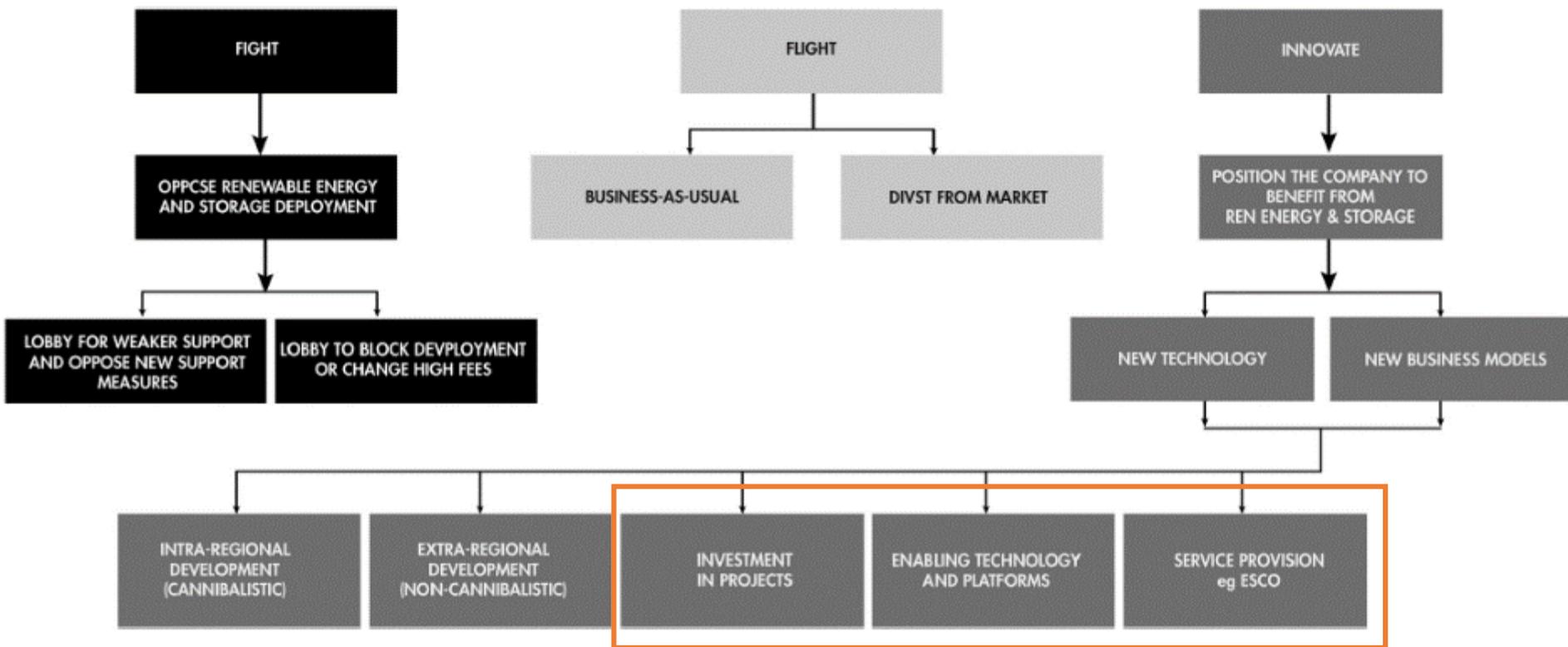


Blockchain Demand Is Building At Accenture, Amazon, Microsoft
Investor's Business Daily - May 18, 2018

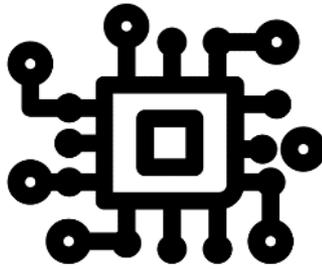
Accenture (ACN) and IBM (IBM) are seeing high demand for consulting and solution-building services around blockchain, says a Keybank ...



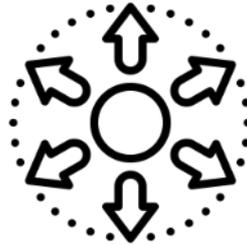
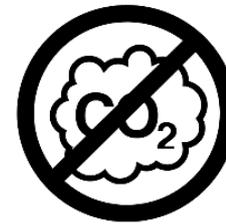
Estrategia - empresas de energía



Green, J., & Newman, P. (2017). Citizen utilities: The emerging power paradigm. *Energy Policy*, 105, 283-293.



B BLOCKCHAIN



Modelos de
negocio



Cooperación



Estrategia



IT y diseño

¡Gracias!

Juan Manuel España

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Investigador – EnergEIA

Universidad EIA

Lecturas recomendadas - artículos

- Abdella, J., & Shuaib, K. (2018). Peer to Peer Distributed Energy Trading in Smart Grids: A Survey. *Energies*, 11(6), 1-22.
- Aitzhan, N. Z., & Svetinovic, D. (2016). Security and privacy in decentralized energy trading through multi-signatures, blockchain and anonymous messaging streams. *IEEE Transactions on Dependable and Secure Computing*.
- Albrecht, S., Reichert, S., Schmid, J., Strüker, J., Neumann, D., & Fridgen, G. (2018, January). Dynamics of Blockchain Implementation-A Case Study from the Energy Sector. In *Proceedings of the 51st Hawaii International Conference on System Sciences*.
- Green, J., & Newman, P. (2017). Citizen utilities: The emerging power paradigm. *Energy Policy*, 105, 283-293.
- Lombardi, F., Aniello, L., De Angelis, S., Margheri, A., & Sassone, V. (2018). A blockchain-based infrastructure for reliable and cost-effective IoT-aided smart grids.
- Long, C., Wu, J., Zhang, C., Cheng, M., & Al-Wakeel, A. (2017). Feasibility of peer-to-peer energy trading in low voltage electrical distribution networks. *Energy Procedia*, 105, 2227-2232.
- Mannaro, K., Pinna, A., & Marchesi, M. (2017, September). Crypto-trading: Blockchain-oriented energy market. In *AEIT International Annual Conference, 2017* (pp. 1-5). IEEE.
- Mattila, J., Seppälä, T., Naucler, C., Stahl, R., Tikkanen, M., Bådenlid, A., & Seppälä, J. (2016). *Industrial blockchain platforms: An exercise in use case development in the energy industry* (No. 43). The Research Institute of the Finnish Economy.
- Mengelkamp, E., Notheisen, B., Beer, C., Dauer, D., & Weinhardt, C. (2018). A blockchain-based smart grid: towards sustainable local energy markets. *Computer Science-Research and Development*, 33(1-2), 207-214.
- Mihaylov, M., Jurado, S., Avellana, N., Van Moffaert, K., de Abril, I. M., & Nowé, A. (2014, May). NRGcoin: Virtual currency for trading of renewable energy in smart grids. In *European Energy Market (EEM), 2014 11th International Conference on the* (pp. 1-6). IEEE.
- Perez-Diaz, A., Gerding, E., & McGroarty, F. Decentralised Coordination of Electric Vehicle Aggregators.
- Sijie, C. H. E. N., & Chen-Ching, L. I. U. (2017). From demand response to transactive energy: state of the art. *Journal of Modern Power Systems and Clean Energy*, 5(1), 10-19.
- Rahimi, F., Ipakchi, A., & Fletcher, F. (2016). The changing electrical landscape: end-to-end power system operation under the transactive energy paradigm. *IEEE Power and Energy Magazine*, 14(3), 52-62.
- Yli-Huumo, J., Ko, D., Choi, S., Park, S., & Smolander, K. (2016). Where is current research on blockchain technology?—a systematic review. *PloS one*, 11(10), e0163477.
- Zhang, C., Wu, J., Cheng, M., Zhou, Y., & Long, C. (2016). A bidding system for peer-to-peer energy trading in a grid-connected microgrid. *Energy Procedia*, 103, 147-152.
- Zhang, C., Wu, J., Zhou, Y., Cheng, M., & Long, C. (2018). Peer-to-Peer energy trading in a Microgrid. *Applied Energy*, 220, 1-12.
- Zhang, C., Wu, J., Long, C., & Cheng, M. (2017). Review of existing peer-to-peer energy trading projects. *Energy Procedia*, 105, 2563-2568.

Lecturas recomendadas - otros

Tesis de doctorado y maestría

- **Buth, M.C. (2018).** *Blockchain technology for peer-to-peer trading in the Dutch electricity system from hype to reality* (Master's Thesis, TU Eindhoven).
- Orlov, A. (2017). *Blockchain in the electricity market: identification and analysis of business models* (Master's thesis, HEC).
- Soysal, C. (2017). *Innovative Business Models for Distributed PV in Brazil. IEEE Masters Thesis.*
- Yu, Q. (2018). *Design, Implementation, and Evaluation of a Blockchain-enabled Multi-Energy Transaction System for District Energy Systems* (Master's thesis, ETH).

Reportes de industria y consultorías

- Emerton (2017), *Rewiring energy markets: an opportunity for blockchain technologies? Point of view* – By Romain Bonenfant, Sébastien Plessis and Sébastien Zimmer
- PwC (2016), *Blockchain – an opportunity for energy producers and consumers? PwC global power & utilities*
- **DENA – ESMT (2016), Blockchain in the energy transition. A survey among decision-makers in the German energy industry**
- The GridWise Architecture Council (2015), *GridWise Transactive Energy Framework Version 1.0*

Videos

- Epicenter. 2017, March 14. Carsten Stöcker: How Blockchains Will Power the Energy Grids of Tomorrow (Episode 174). <https://youtu.be/9q5gsKo9DHE>
- Global Blockchain Business Council. 2018, July 12. Blockchain & Energy Industry 101 Panel. <https://youtu.be/0lpboWdcRg4>
- **Leonardo Energy - UCL Energy Institute. 2017, June 21. Prof David Shipworth's Inaugural Lecture 'Transactive Energy: Turning the energy system outside-in'.** <https://youtu.be/dhMBHLfvrC8>

Podcasts

- The Interchange (2018). A Guide to Blockchain and Energy. <https://goo.gl/WyU2fb>
- The Interchange (2018). Blockchain for Energy, Part Deux: Real-World Use Cases. <https://goo.gl/PzkR85>
- The Interchange (2018). What Will Energy Blockchain Become? <https://goo.gl/7h1njc>
- The Interchange (2018). How Blockchain Peer-to-Peer Energy Trading Might Work <https://goo.gl/qPCknc>

Oportunidades en el sector

Blockchain crea oportunidades extraordinarias para la **convergencia** de negocios

Crear nuevo valor

- Clientes acceden nuevos mercados
- Empresas de energía expanden servicios (más que cables y postes)
- Redes financieras expanden su red

Optimizar el ecosistema

- Aumenta eficiencia
- Traceabilidad, integra generación behind the meter al mercado

Reducir riesgos

- Más información para predecir la generación y demanda
- Más confianza de los usuarios

Actores relevantes: prosumidores y **agregadores de prosumidores**, operador del sistema (regulador para el largo plazo y operación presente), **redes financieras**

Oportunidades de investigación

- Diseño de políticas públicas para tokens
- Nuevas arquitecturas de sistemas energéticos
- Algoritmos para la operación de micro-redes integrando mecanismos de mercado, cumpliendo con las exigencias de un sistema de potencia
- Alineación de incentivos y economía de tokens
- Privacidad y gobernanza
- Integración con sistemas de gestión de energía

Retos de la tecnología

Políticas y regulación

- Integración con mercado mayorista
- *Sandbox* regulatorio
- Supervisión y control de nuevos actores
- Protección de los usuarios, transparencia y privacidad

Negocios

- Usabilidad
- Confianza de los grupos de interés
- Prueba de go-to-market y monetización
- Financiamiento

Tecnológicos:

- Sistemas de medición y control
- Costo de las plataformas y del hardware
- Escalamiento, latencia, memoria, eficiencia, energía
- Seguridad de sistemas tradicionales TI y propios de Blockchain (51% attack)
- Estandarización