

RPS Collaborative Webinar

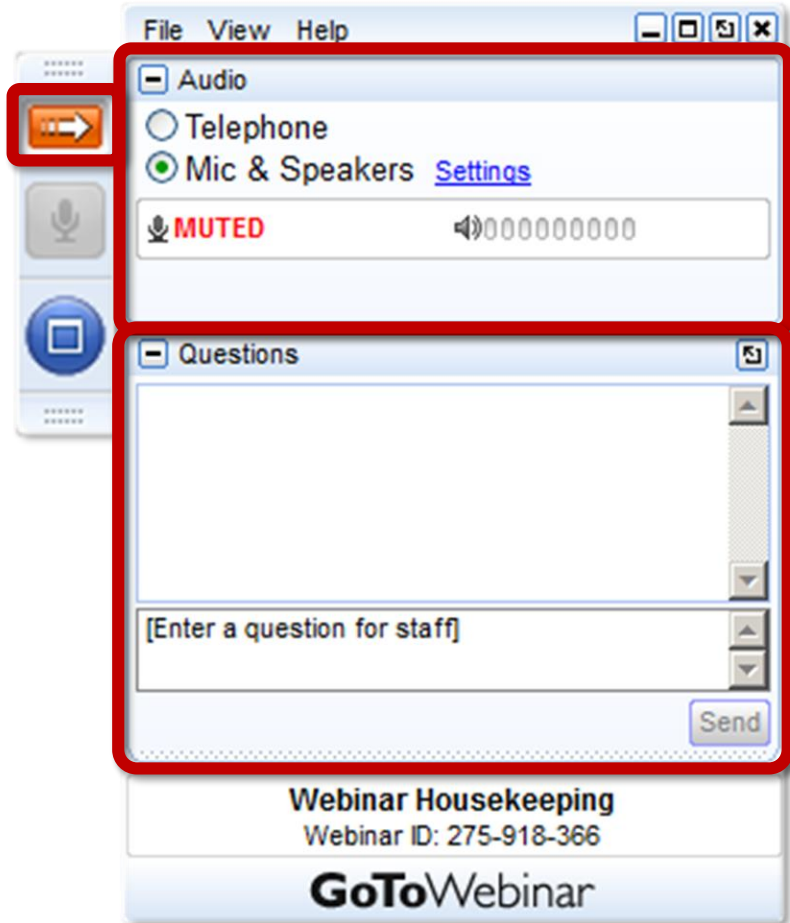
Blockchain Technology for RECs, Tracking Systems, and Other Energy Market Applications

Hosted by
Warren Leon, Executive Director, CESA

July 17, 2018



Housekeeping



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Clean Energy States Alliance



RPS Collaborative

- With funding from the Energy Foundation and the U.S. Department of Energy, CESA facilitates the **Collaborative**.
- Includes **state RPS administrators, federal agency representatives,** and other stakeholders.
- Advances dialogue and learning about RPS programs by **examining the challenges and potential solutions** for successful implementation of state RPS programs, including **identification of best practices**.
- To sign up for the Collaborative listserv to get the **monthly newsletter** and announcements of **upcoming events**, see:
www.cesa.org/projects/renewable-portfolio-standards



Webinar Speakers



Alex Anich, Manager—Renewable Market Intelligence, NRG Renewables



Ben Gerber, Executive Director, Midwest Renewable Energy Tracking System (MRETS)



Warren Leon, Executive Director, Clean Energy States Alliance (moderator)





NRG Energy, Inc

Renewable Energy Certificates

Blockchain & Distributed Ledger Technology (DLT)

2018



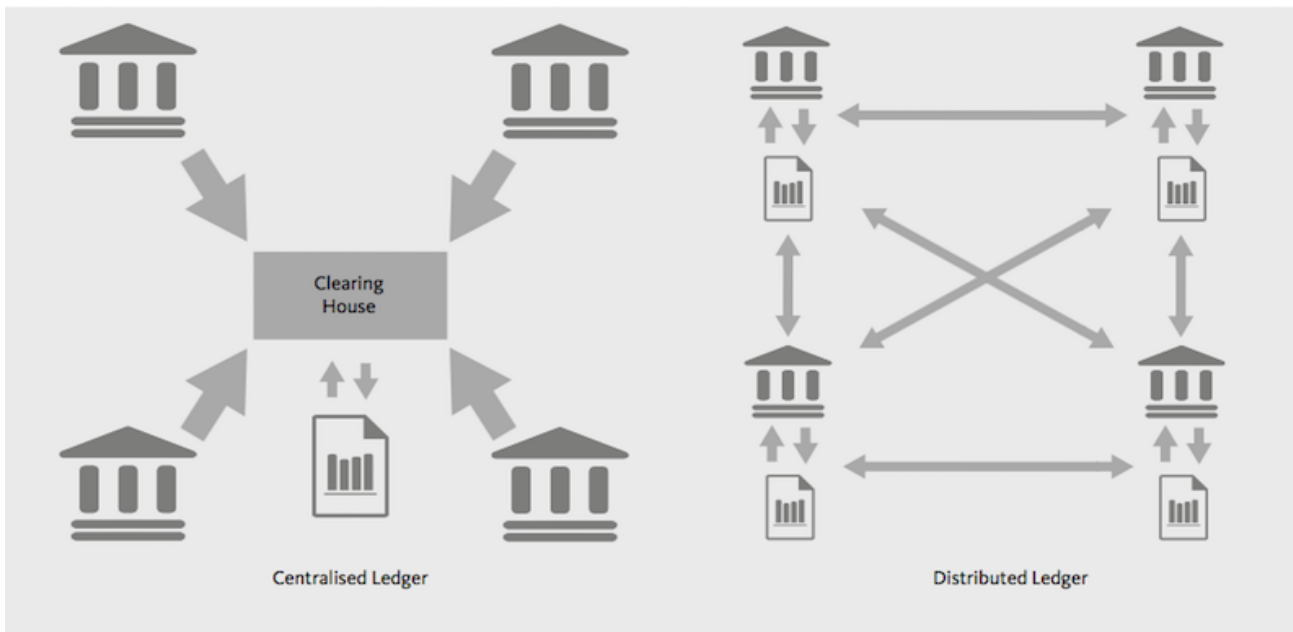
Roadmap for Today



- Some basic concepts
- The technology
- A little history & perspective
- Blockchain for RECs



Centralized vs. Distributed Ledgers



http://fintechnews.ch/blockchain_bitcoin/central-banks-face-bitcoin-pressure/3819/

- Centralized databases: predominant form of technology since 1970s. A central third party records official transactions on behalf of market participants, while each participant maintains a separate, internal database. Databases regularly conflict and require costly reconciliation efforts.
- Distributed ledgers: Started in 2009 with bitcoin and blockchain. Market participants synchronize to and share a single database with each other in real-time. Peer-to-peer network where transactions are encrypted and authenticated.

Some Basic Concepts



- Computers, and particularly the internet, enable virtually costless replication of digital content through file copying
 - Very useful for lots of content (e.g., contracts and similar business documents)
 - Problematic for copyrighted materials (e.g., Napster) or other singular content (e.g., title to a car, or a vote in an election)
- Is it possible to create unique and secure digital 'value' that can be transferred from one party to another, but not copied?
- Blockchain and Distributed Ledger Technology (DLT) accomplishes this by:
 - Preventing copying through encryption
 - Maintaining anonymity of confidential information through encryption
 - Preventing competing claims of ownership through shared access to a common set of records

More Basic Concepts



- Distributed ledger – in a fully open blockchain application, any party has access to the full ledger containing all transactions and balances
- Transfer, not copy – unlike standard computer files, the blockchain’s digital records of value are unique
- ‘Trust’ – because of the distributed ledger, the system does not rely on parties like banks or governments to keep accurate records; the resulting system is sometimes referred to as ‘trustless’
- Chain of custody/provenance – the current state of the ledger effectively contains the full history of ownership of each record; any attempt to change earlier records would not reconcile

The Technology

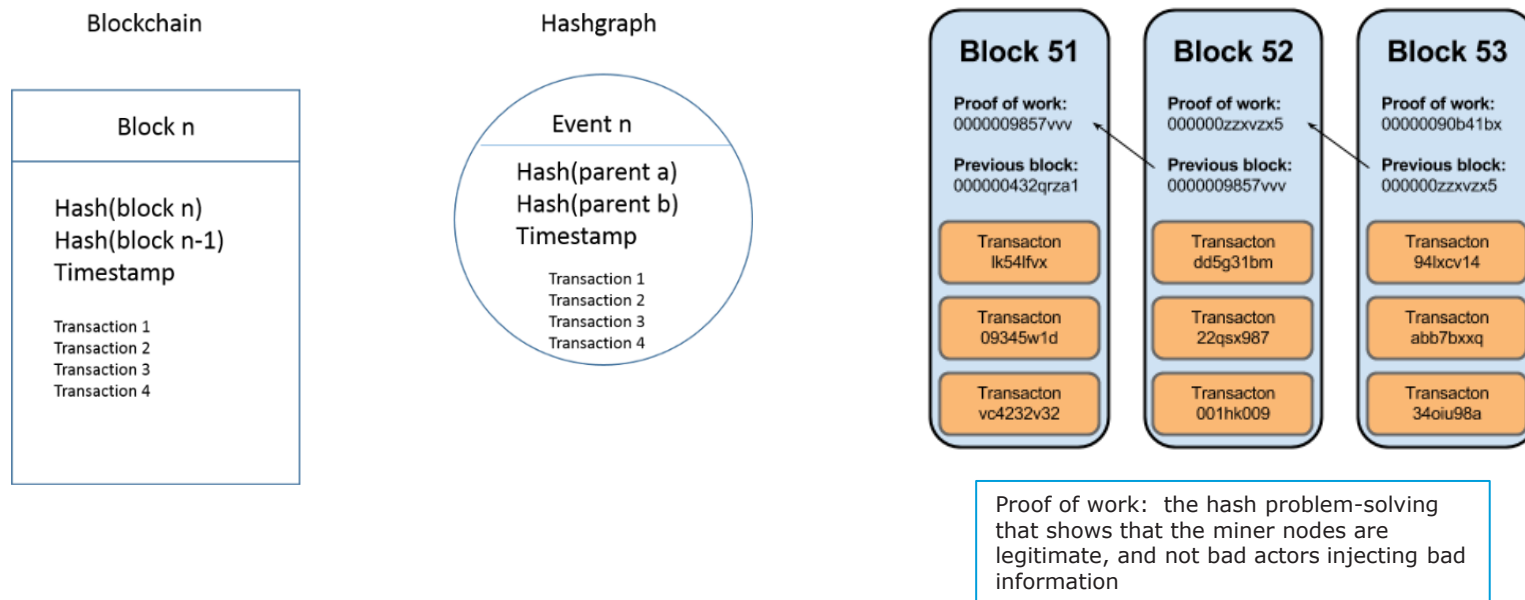


- Hash – a non-reversible, deterministic mathematical function that maps a set of inputs to a set of outputs
 - For a given set of inputs a given hash will always return the same set of outputs
 - There is no inverse function to produce the inputs from a given set of outputs
- Blocks, in a chain; blockchain
 - A 'block' is a set of transactions, records, etc that are collectively hashed
 - The header on each block is a hash of the data in the block as well as the header from the previous block
 - The blocks are linked into a 'chain' that continues to grow with each hash



Blocks, in a Chain

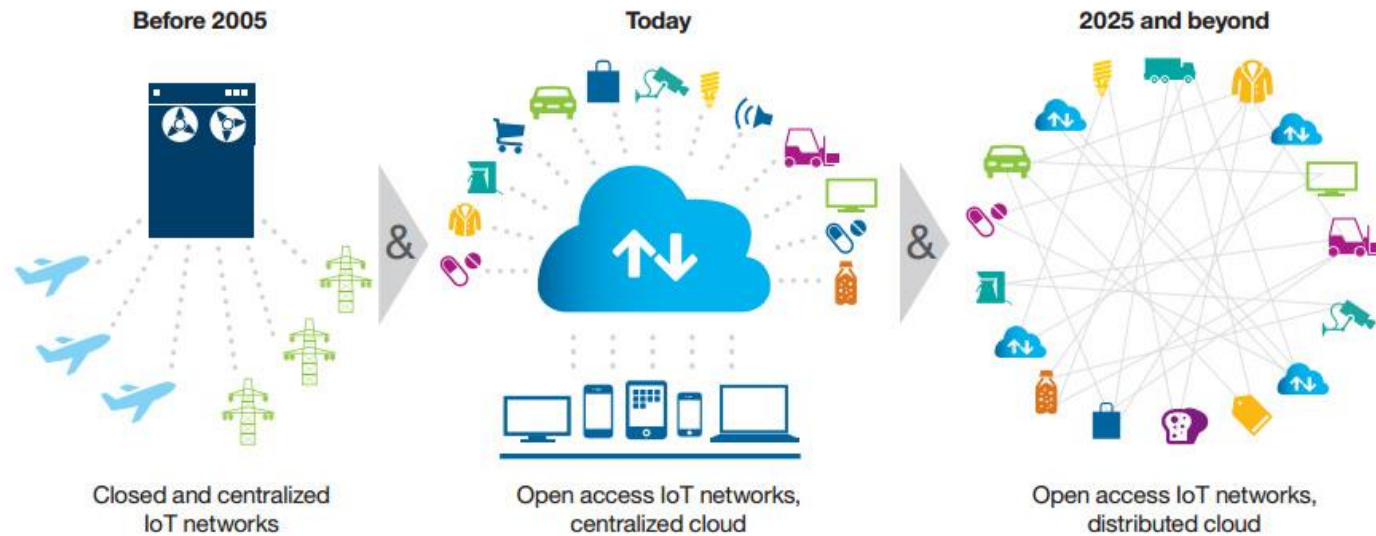
- Periodically, (~ every 10 minutes for Bitcoin), miners collect transactions into a 'block' and compete to 'solve' a hash that meets the pre-defined criteria for the header
- Once solved and confirmed by a majority of the nodes, the block is added to the chain of all previous blocks



A Little History & Perspective



- Major steps in digital evolution: mainframe, PC, internet, portability, social media, HM interface, blockchain?



Graphic: Steemit.com

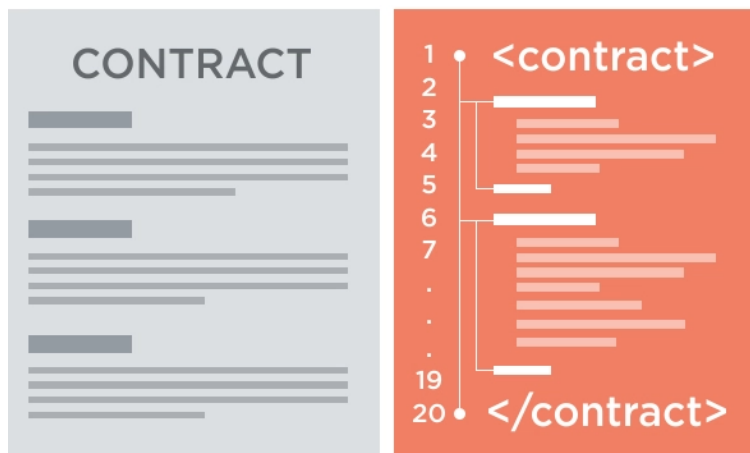
- The early ideas for non-replicable digital content date to mid-90s
- October 2008: Satoshi Nakamoto, *Bitcoin: A Peer-to-Peer Electronic Cash System*, the seminal paper describing the design and protocols that made Bitcoin possible, and laid the groundwork for blockchain technology



Smart Contracts

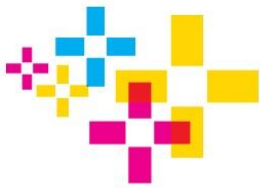
- Computer protocols recorded on the distributed ledger that validate and enforce some type of contract
- Protocols are actually part of the ledger just like actual transactions and are likewise authenticated and tamper-proof
- Enable full or partial self-execution and/or self-enforcement of a contractual clause
- Simple example:

If today's date is equal to 7/17/2018, then transfer asset from Party A to Party B. Otherwise, do nothing.





Blockchain for RECs



NRG Blockchain RECs Are You Asking The Right Questions?

Blockchain and DLT are not Bitcoin!

What do you want to solve for?

- Speed?
 - Transaction verification speed
 - Transactions volume
- Efficiency?
 - Cost
 - Volume
 - Latency
- Security?
 - Confidentiality
 - Encryption

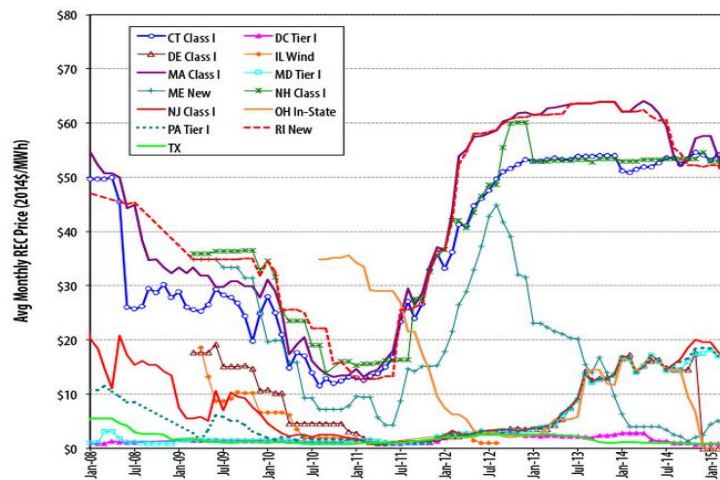
REC Market Challenges



National Market Snapshot

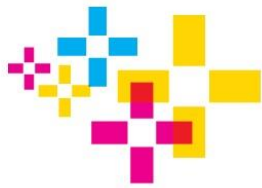
- ❖ **Fragmented Marketplace:** Inconsistent regional and local market practices and regulations
- ❖ **Large Units of Measurement:** 1 MWh units incongruent with mass market
- ❖ **Opaque Tracking:** Costly certification and tracking measures
- ❖ **Protracted Timing:** RECs transacted on a monthly cycle
- ❖ **Disparate Market Systems:** Multiple IT platforms

Illiquid, Volatile and Convoluted Market



Current construct restricts market participants, increases transaction costs, and impacts working capital.

Blockchain can alleviate market constraints and add value to commercial operations



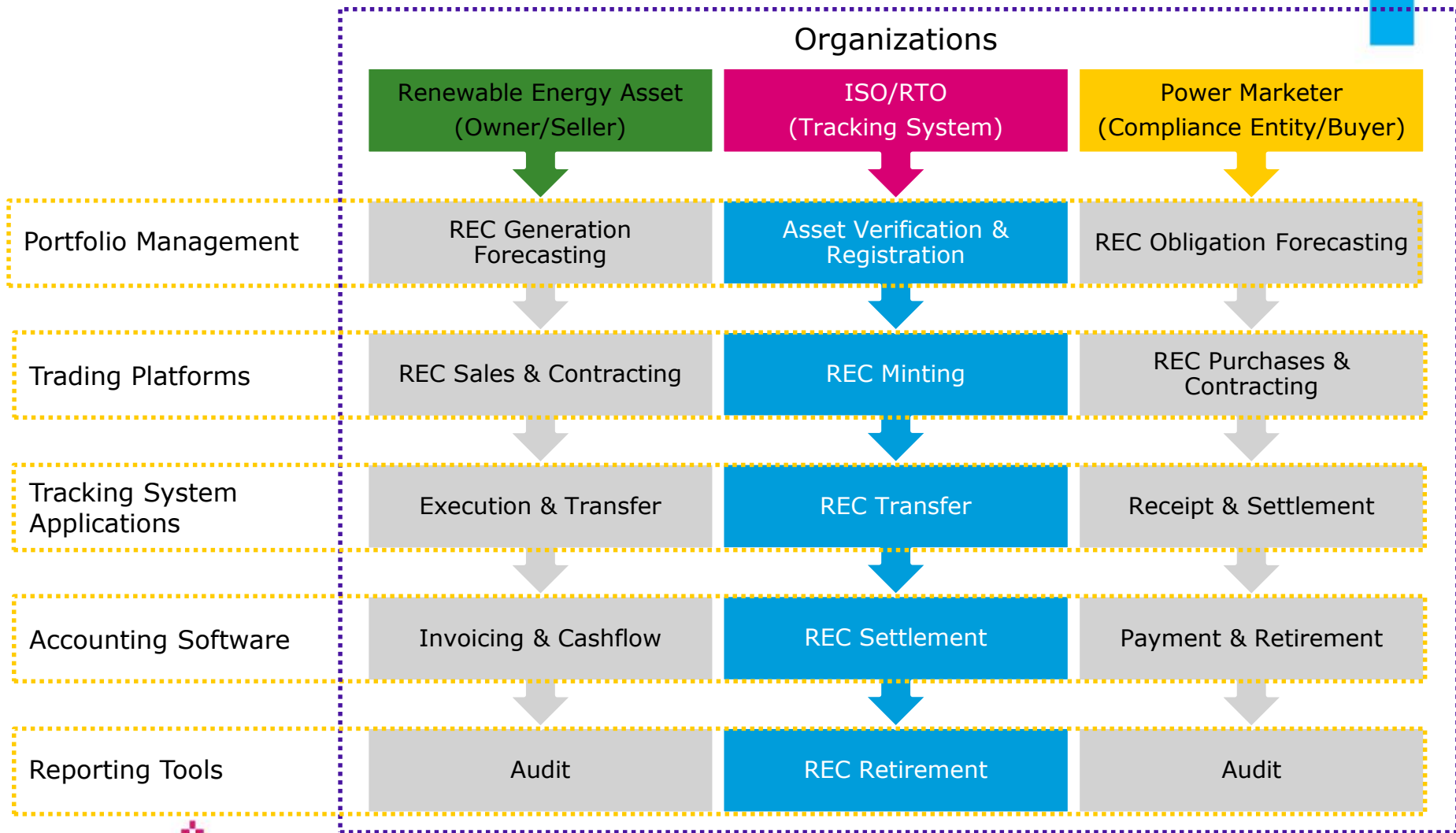
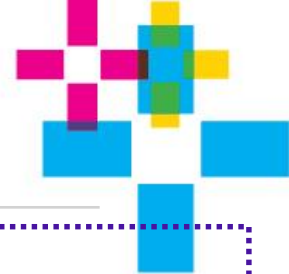
NRG Blockchain RECs

Are You Asking The Right Questions?

What makes up the a REC market?

- Tracking System?
 - Counterparty Risk Issues
- Participants or Counterparties?
 - Buyers and Sellers
 - Traders and Brokers
 - Corporate Sustainability Buyers
 - End Consumers
- Transactions between counterparties?
 - Data systems infrastructure of the market

Lifecycle of a Renewable Energy Credit (OTC REC Market - Process Chain of Custody)





NRG Blockchain RECs Key Components

Key Components:

- Proof of Concept
- Bottom Up Approach to Solve Market Issues
- Technology focus on speed of transactions, efficiency improvements and cost savings
- Regulators remain component of governance
- Consensus mechanism reflecting market governance requirements

What our project is not:

- Not a commercial product
- Not a new cryptocurrency
 - NO MINING!!!
 - Low energy consumption
 - No currency volatility
- Not an Initial Coin Offering (ICO)
- Not avoiding regulations – developing blockchain and DLT to improve functioning of regulatory processes



NRG Blockchain RECs Current Status

Proof of Concept:

- Simple Minimum Viable Product complete
- Issuance-Transfer-Retirement of RECs
- Blockchain technology focused

Establishing Partnerships:

- Voluntary Markets – current use case discussions with:
 - Nasdaq Market Technology (Technology Partner)
 - Center for Resource Solutions (Green-e REC)
- Compliance Markets
 - Regulatory Partnerships




NRG Blockchain RECs Market Growth

Voluntary market use case presents an opportunity as the market is primed for growth through increased corporate demand.

Key areas discussed:

1. Limitations of Scalability
 1. Current chain-of-custody audit is not scalable
 2. Blockchain REC platform is scalable

2. Corporate US demand is growing
 1. Current volume is ~50m RECs per year
 2. Increasing in near-term by 50% to 100%



Blockchain Technology for RECs, Tracking Systems, and Other Energy Market Applications

When Blockchain is NOT the Best Option

Benjamin L. Gerber
Executive Director, M-RETS
Clean Energy States Alliance
July 17, 2018 1 p.m. EST

Background

- Mission: M-RETS validates the environmental attributes of energy to serve as a trusted centralized gateway to environmental markets.
- **Independent non-profit**
- Developed out of stakeholder process with regulators, renewable energy advocates, generators & utilities.

PLATFORM ECONOMY + AGE OF THE CUSTOMER

“The concept is simple: Instead of offering consumers a discrete set of products, companies are instead increasingly developing networks or systems that enable participants to exchange information, services and products in many different directions. Think AirBnB, Uber or Amazon.”

CUSTOMERS expect seamless interactions and compare experiences globally—not just between direct competitors

*<http://midwestenergynews.com/2017/10/05/platform-model-will-be-key-for-illinois-future-power-grid/>

Rapidly changing industry

IONIQ UNLIMITED+
Experience a new sense of freedom. Enjoy convenient, affordable and worry-free driving. Introducing the Ioniq Unlimited+ Subscription Program. Currently, Ioniq Unlimited+ is only available to California residents. Starting at \$275 per month.

One monthly payment covers it all.

- Unlimited Mileage
- Charging Reimbursement*
- Hassle-free Transaction
- Complimentary Maintenance and Wear Items*
- Initial Taxes, Title, License and Fees Included

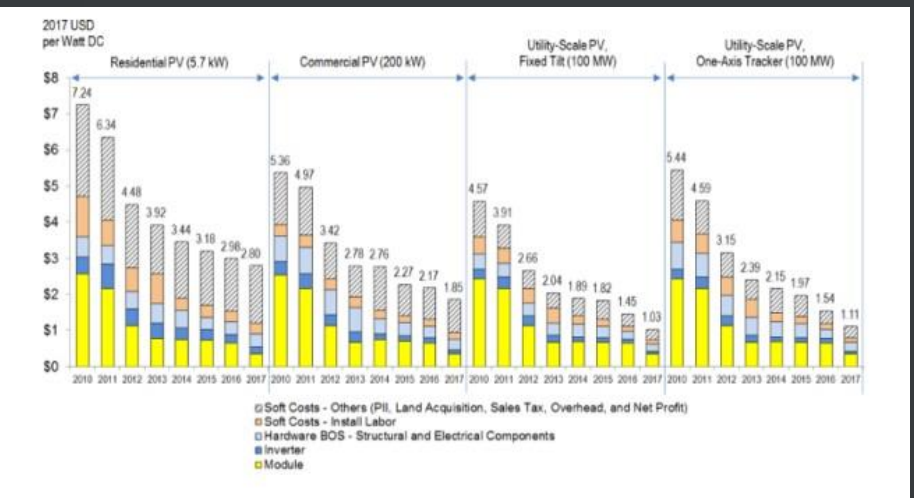
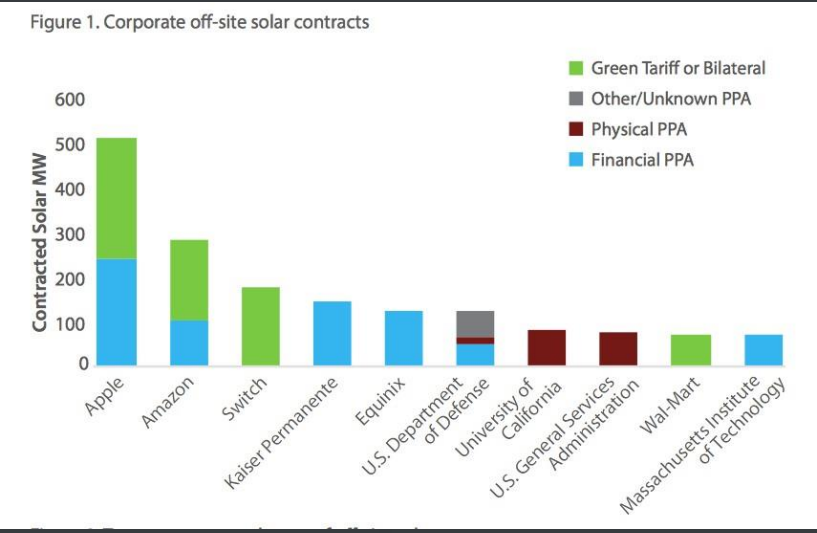
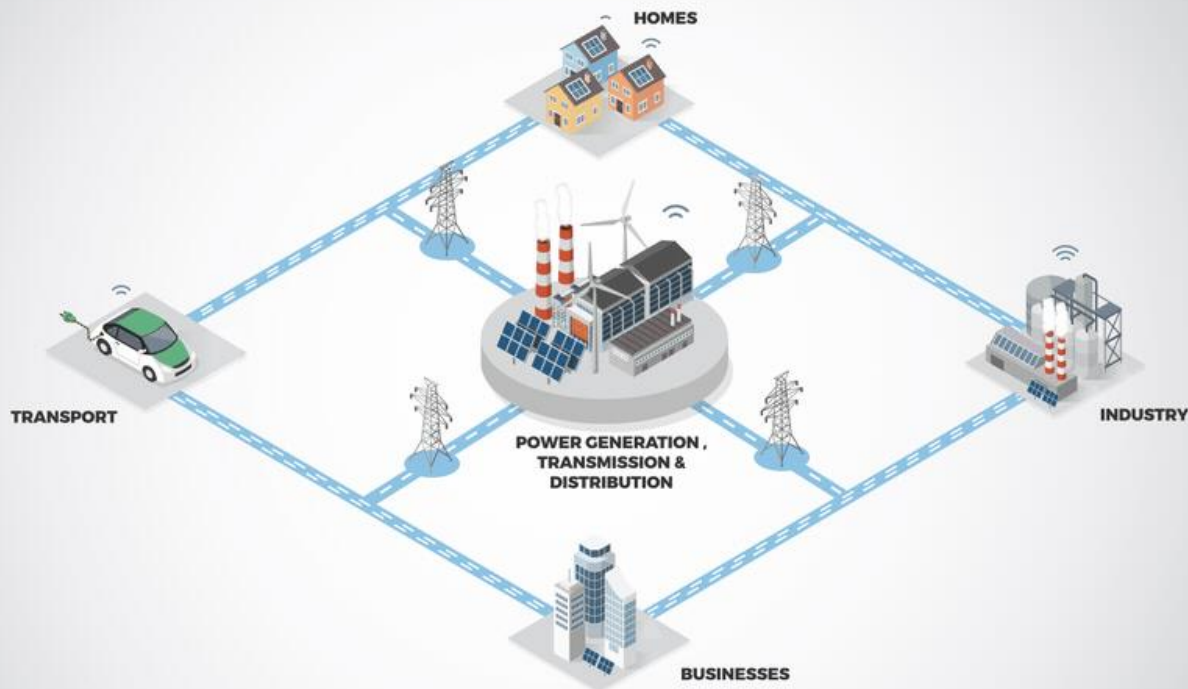


FIGURE 1: NREL https://www.nrel.gov/docs/fy17osti/69081.pdf?utm_source=NREL+Voluntary+Green+Power+Procurement&utm_campaign=9f9c95018a-EMAIL_Green+Power_2017_09_12&utm_medium=email&utm_term=0_4ebad47ab2-9f9c95018a-289372179 & <https://pv-magazine-usa.com/2017/09/14/nrel-u-s-fixed-tilt-solar-plant-costs-fall-to-1-03watt-dc-with-charts/>



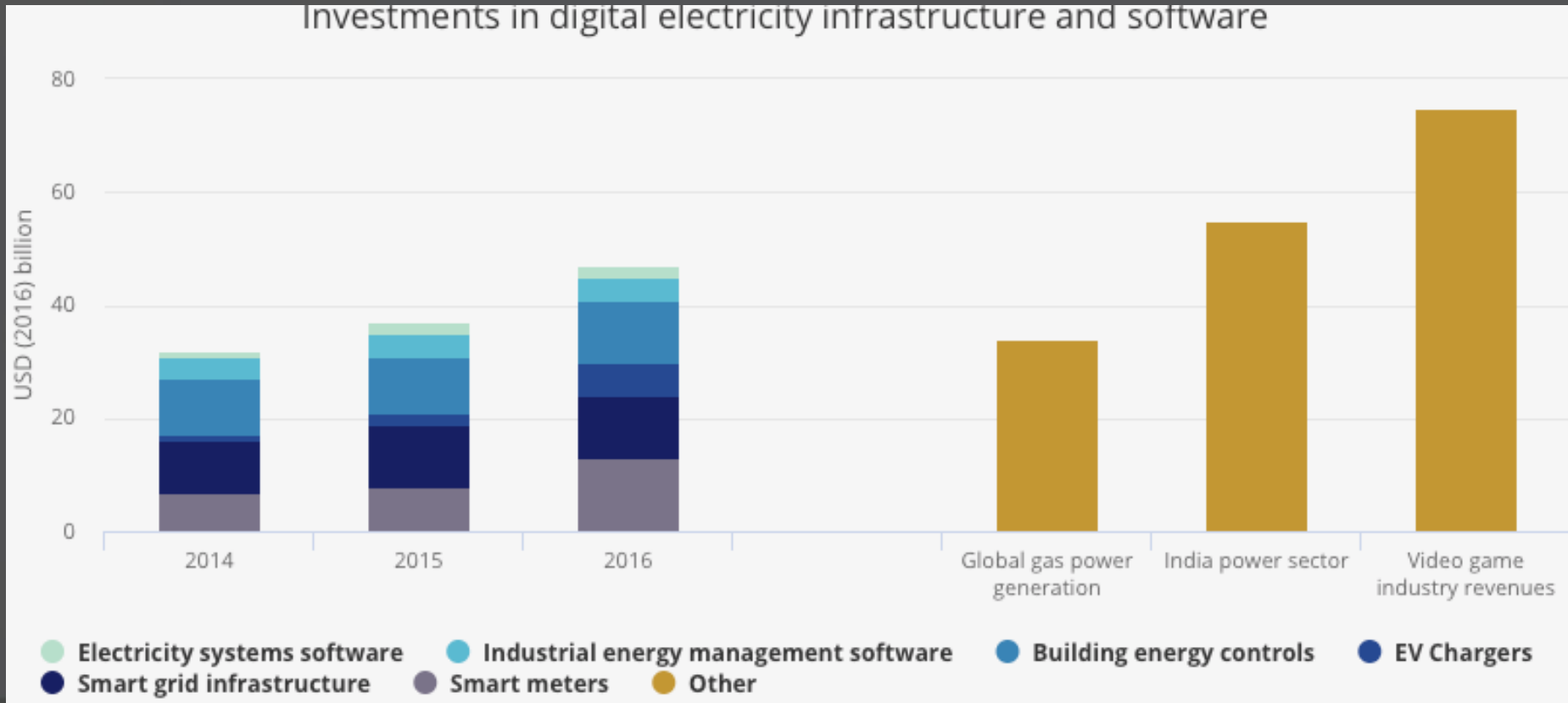
Digital transformation & blurred lines



Digitalization is blurring the distinction between **generation & consumption**



Investment data shows potential



Utility Sector Digital Investments



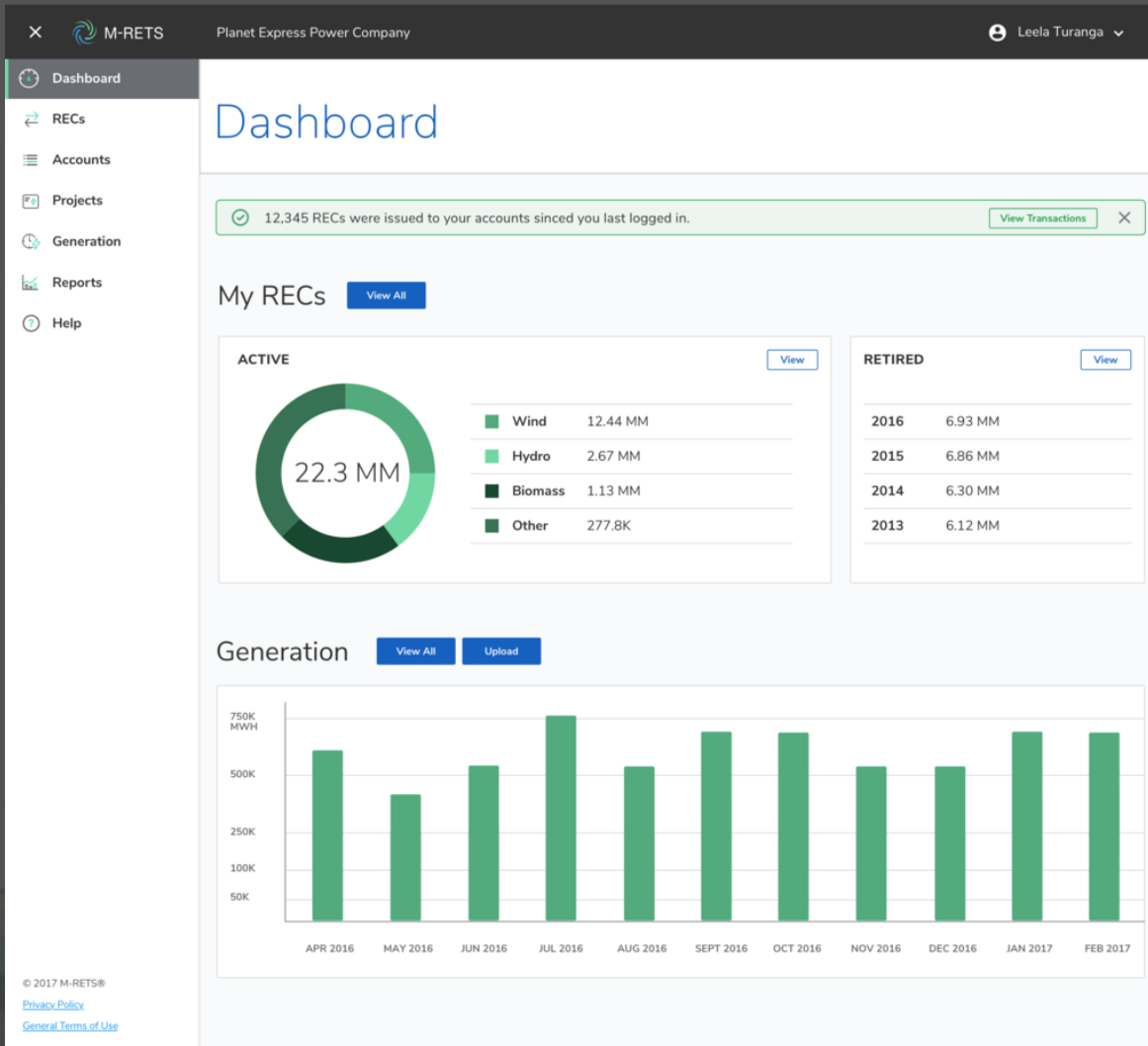
Barriers to digital transformation

- 30-40 year time horizons vs. 3-5 in software
- Costs are unpredictable
- Utility not seen as innovation hubs
- Tech moves faster than regulation

M-RETS Platform

Launched: 12/13/2017

Out of Date: 12/14/2017



A CLEAN
 DASHBOARD
 WITH **EASILY**
 NAVIGABLE MENU
 AND QUICK
 ACCESS TO
 FREQUENT
 ACTIONS

CLEAR SUMMARIES OF MAJOR PLATFORM TRANSACTIONS

M-RETS Planet Express Power Company

Search for accounts or projects ...

Bess Griffin

Transfer RECs

STATUS: Updated 1 minute ago

Transferring 82,596 active RECs from

Account	ID	Project	Fuel Type	Vintage	State	Quantity	
REC Pool	M763	Brighton Wind (Unit 1)	Wind	09/2016	MN	41,480	Details
REC Pool	M763	Happy Valley Windfarm Inc	Wind	09/2016	MN	41,116	Details

to these active accounts:

Accounts	Percent	Amount
MI Active RECs	20 %	16,519
MN Active RECs	20 %	16,519
ND Active RECs	20 %	16,519
SD Active RECs	20 %	16,519
WI Active RECs	20 %	16,519

[Complete Transfer](#) [Back](#)

RECs will be immediately transferred to the accounts listed at left. You can [go back to make changes](#) to this transaction.

WHY **NOT** BLOCKCHAIN?

It will prevent us from finding aliens...

Crypto-currency craze 'hinders search for alien life'

By Chris Baraniuk
Technology reporter

5 hours ago



If there is intelligent life out there, it might be broadcasting signals across the universe

Scientists listening out for broadcasts by extra-terrestrials are struggling to get the computer hardware they need, thanks to the crypto-currency mining craze, a radio-astronomer has said.

TECH INDUSTRY

This coal power plant is being reopened for blockchain mining

The now shuttered coal-fired power station on Australia's east coast will offer cheap power prices to blockchain operators.

BY CLAIRE REILLY / APRIL 11, 2018 12:27 AM PDT



That's the idea behind the Blockchain Application Centre -- an Aussie tech initiative that will see one of the country's now-shuttered coal-fired power plants reopened to provide cheap power for blockchain applications.

It's the work of Australian tech company IOT Group, which has partnered with local power company Hunter Energy on the project. According to The Age, Hunter Energy will recommission the Redbank power station in the Hunter Valley, two hours drive north of Sydney.

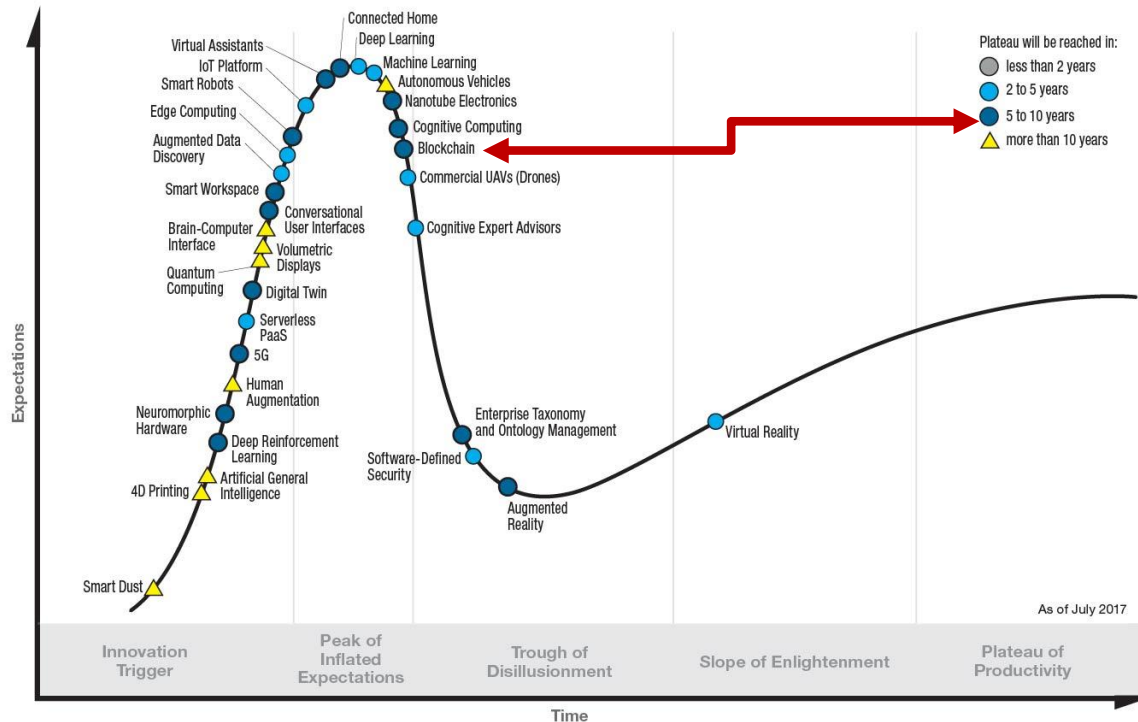
Once the power plant is reopened (expected to be completed within 12 months), it will offer wholesale or "pre-grid" power prices to blockchain companies, allowing them to do things like mining cryptocurrencies, without having to pay retail power prices.

but make coal great again!



Gartner Hype Cycle

Gartner Hype Cycle for Emerging Technologies, 2017



gartner.com/SmarterWithGartner

Source: Gartner (July 2017)
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Gartner

Decision Analysis

- Scalability & flexibility
- Cost considerations – emerging technologies are risky, often unproven and expensive to develop
- Maintenance – small developer community = higher costs
- Leading/cutting/bleeding edge
- Security – risk analysis – nothing is safe, run if someone tells you that

What **experts** say

If trust and robustness aren't an issue, there's nothing a blockchain can do that a regular database cannot.

This is a key point on which there is so much misunderstanding. In terms of the types of data that can be stored, and the transactions that can be performed on that data, blockchains don't do anything new. And just to be clear, this observation extends to "smart contracts" as well, despite their sexy name and image. A smart contract is nothing more than a piece of computer code which runs on every node in a blockchain – a decades-old technology called **stored procedures** does the same for centralized databases. (You also cannot use a blockchain if this code needs to *initiate* interactions with the outside world.)

While a decentralization consensus mechanism offers some critical benefits, such as fault tolerance, a strong guarantee of security, political neutrality, and authenticity, it comes at the cost of scalability. The number of transactions the blockchain can process can never exceed that of a single node that is participating in the network. In fact, the blockchain actually gets weaker as more nodes are added to its network because of the inter-node latency that logarithmically increases with every additional node.

"Do we really need blockchain for wholesale power trading? No one is really complaining about the timing or cost of those transactions. It's such early days for [blockchain and] wholesale power trading – it could be a roaring success or a massive failure."

Stuart Ravens
Principal Research Analyst, Navigant

Weighing the Rewards

The benefits offered by a private blockchain – faster transaction verification and network communication, the ability to fix errors and reverse transactions, and the ability to restrict access and reduce the likelihood of outsider attacks – may cause prospective users to be wary of the system. The need for a blockchain system at all presupposes a degree of mistrust, or at least an acknowledgement that all users' incentives may not be aligned.

<https://www.multichain.com/blog/2016/03/blockchains-vs-centralized-databases/>

<https://hackernoon.com/blockchains-dont-scale-not-today-at-least-but-there-s-hope-2cb43946551a>

<https://hbr.org/2017/03/how-safe-are-blockchains-it-depends>



Issues with blockchain

- 93% of bitcoin mined by managed consortiums and none use “smart contracts” for payouts
- Trust shifts from humans to software—auditing software is hard
- GIGO— blockchain makes it easier to audit when data is tampered with but not necessarily whether it is valid upon entry

Benefits of Decentralization?

*"Blockchain technology is going to change consumer behavior around ownership and security. **Now, we feel much safer having a business own and manage our sensitive information rather than bearing the burden ourselves. The rise of decentralization and the ability to have more control over your own personal assets will change that mindset.** More and more businesses will be pressured to shift data ownership back to their customers. Those that resist may get left behind." - Matt Howells-Barby, Global Director of Acquisition, HubSpot*

Source: <https://research.hubspot.com/emerging-tech-for-smbs>

Do not fall into this Trap...



Blockchain may be a very **expensive/inefficient** way to go from Phase 1 to Phase 3.

Question to ask - what **problem(s)** are we trying to solve?

- “Smart” contracts?
- Trust?
- Data integrity?
- Public access to data?
- Does the audience have any thoughts?

What problems are we trying to solve?

- So many people fail to really ask this question when looking to “**DISRUPT**”
- Policy important driver—do not discount it’s importance
- Libertarian paradise sounds nice, but we are far from it
- Current database structure with **open** APIs can accomplish most of REC markets may problems

Transactive Energy

- Idea that DG owners can sell excess generation to whomever they wish
- "By another name, 'transactive energy' is advanced rate design focused on creating a marketplace for lots of providers and consumers. "If you envision the utility as the platform, (or the distribution system optimizer — which I think could be a very interesting business for utilities), you need to couple transactive energy with broader reforms that address the utility capital bias. Otherwise you'll end up with a very lopsided market." Sonia Aggarwal Energy Innovation'
- Arizona Corporation Commission opened a Docket on 7/16 specifically on transactive energy

Conclusion

- Blockchain technology holds value and has the potential to revolutionize the energy industry in many ways, sift through the noise, ask tough questions, promote open REC markets using currently proven technology

Thank you for attending our webinar

Warren Leon

RPS Project Director, CESA Executive Director

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and to sign up for our e-newsletter:

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- Replacing Peaker Plants with Battery Storage (7/19)
- Simplifying Resilient Power Design with REopt Lite: A Look at New Features Added to NREL's Solar+Storage Tool (7/25)
- Expanding Solar PV Finance and Markets in Connecticut and Minnesota (8/2)
- Building Markets: Energy Storage in Massachusetts and Offshore Wind in Rhode Island (8/9)

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