DIGITIZATION OF THE ELECTRICAL GRID

"Smart" Cities Brown Bag Lunch, UW Parkside

Professor Ross Astoria, JD/PhD

LEARNING OBJECTIVES, YO

- 1. Describe the present regulatory configuration of the utility sector ("the legal configuration of hydrocarbon infrastructure")
- 2. Outline the transition of capitalist accumulation in the context of the transition to renewables
- 3. Identify blockchain strategies for transitioning to renewables
- 4. Evaluate whether these technologies are "smart" or "not smart" for the "smart" city

CAPITALISM'S TRANSITION

"Old" Capitalist Economy

- "Fordist"
- Centralization
- Production of: consumer products
- Unionization – steady 40-hour work week
- The Consumer and stuffication

"New" Capitalist Economy

- Post-Fordist
- De-centralization
- Production of: "experiences"
- Precarviate
- Digitization

"THE CONSUMER"

Electric City cover, May 1917. As America enters World War I, the housewife confronts modern household appliances (Commonwealth Edison Company).

CAPITAL EXPENDITURE BIAS IN THE ELECTRICAL POWER UTILITY SECTOR

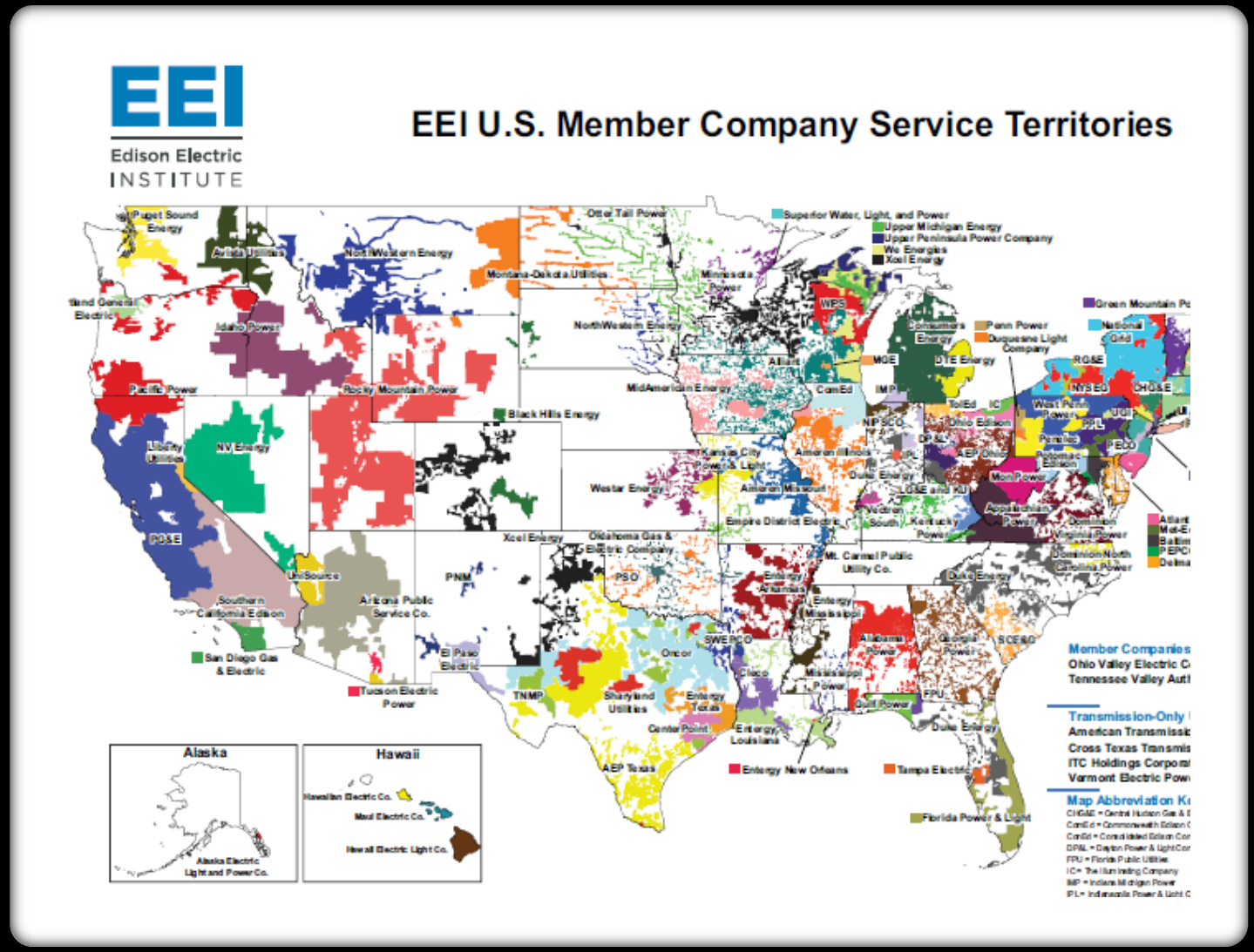
- *Smyth v. Ames* (1898)
  - "a state enactment, or regulation made under the authority of a state enactment, establishing rates for the transportation of persons or property by railroad that will not admit of the carrier earning such compensation as . . . is just to it and the public, would deprive such carrier of its property without due process of law." *Smyth v. Ames*, 169 U.S. 466 (1898).
- *FPC v. Hope Natural Gas* (1944)

CAPITAL EXPENDITURE BIAS IN THE ELECTRICAL POWER UTILITY SECTOR

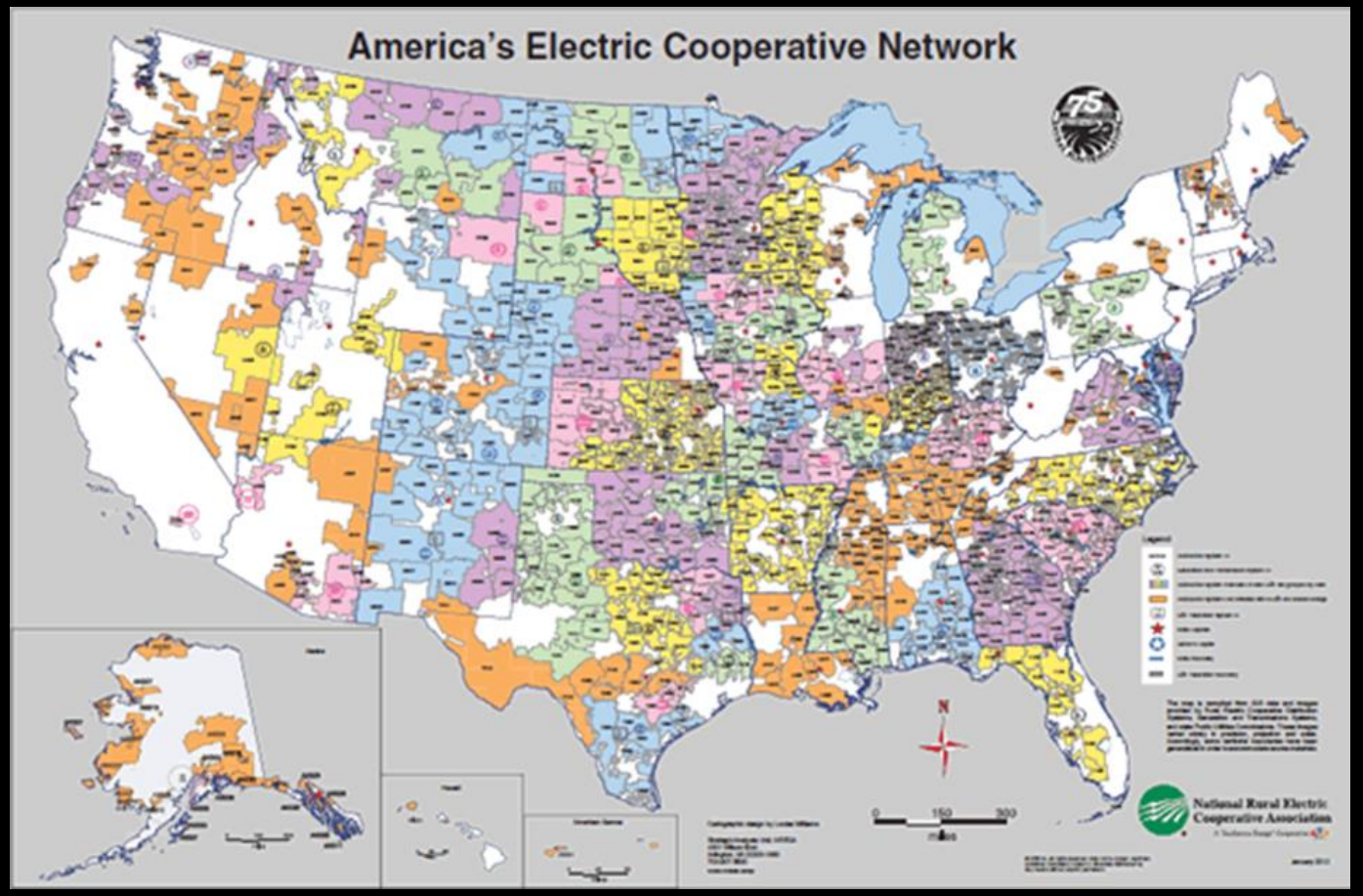
- Consequence 1: Incentive towards fixed capital projects, owned by the utility (not 3rd parties)
- Consequence 2: State first secures capital's profit ("return on investment"); other resources, such as distributed generation and efficiency, valued secondarily and derivatively
- Consequence 3: Well-channeled circuits of capital towards utility "size" projects
- Consequence 4: Establishment of unidirectional relationship between "producer" and "consumer"

GEOGRAPHICALLY BOUNDED

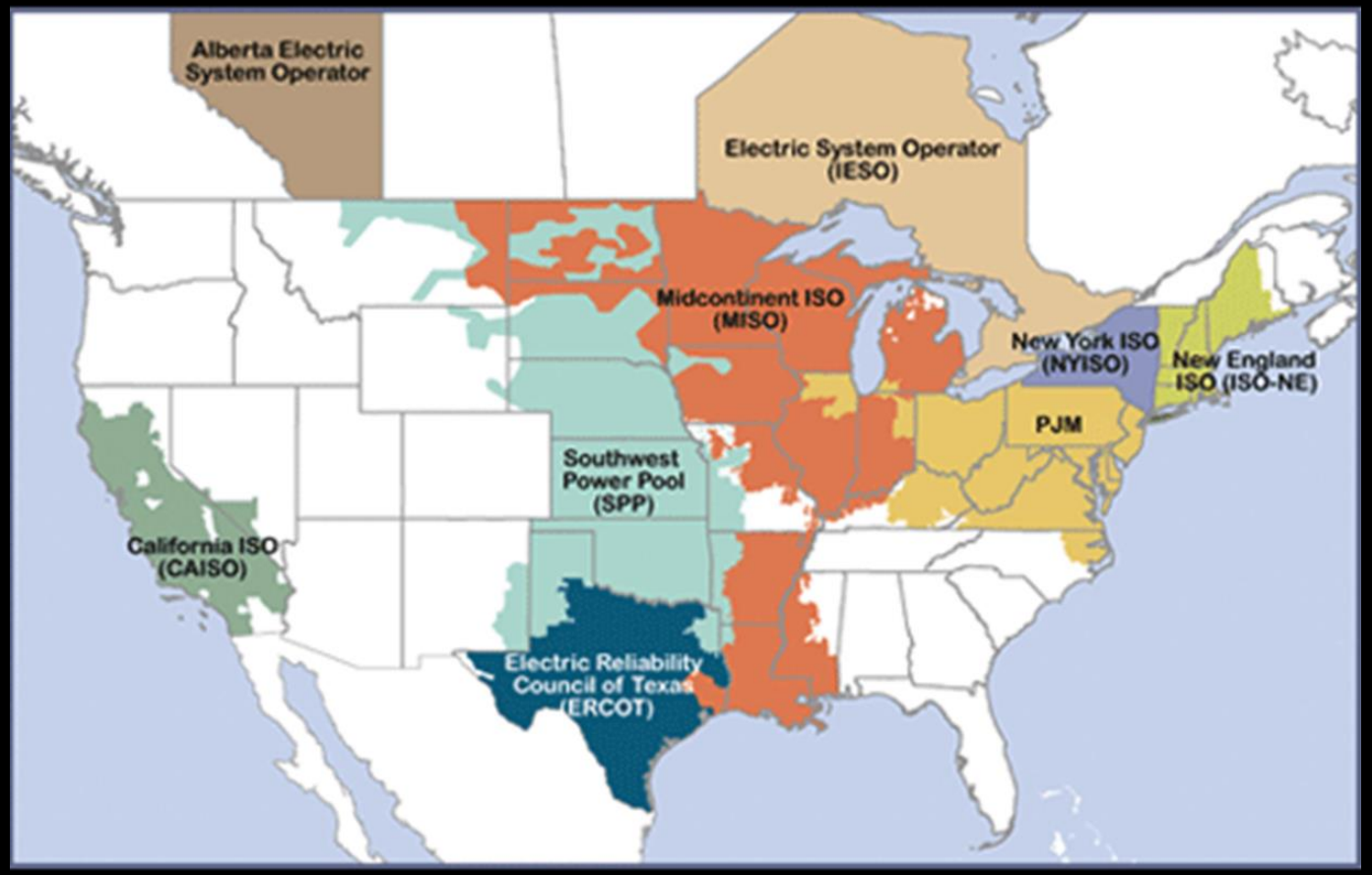
- The utility's ledger is also geographically bounded



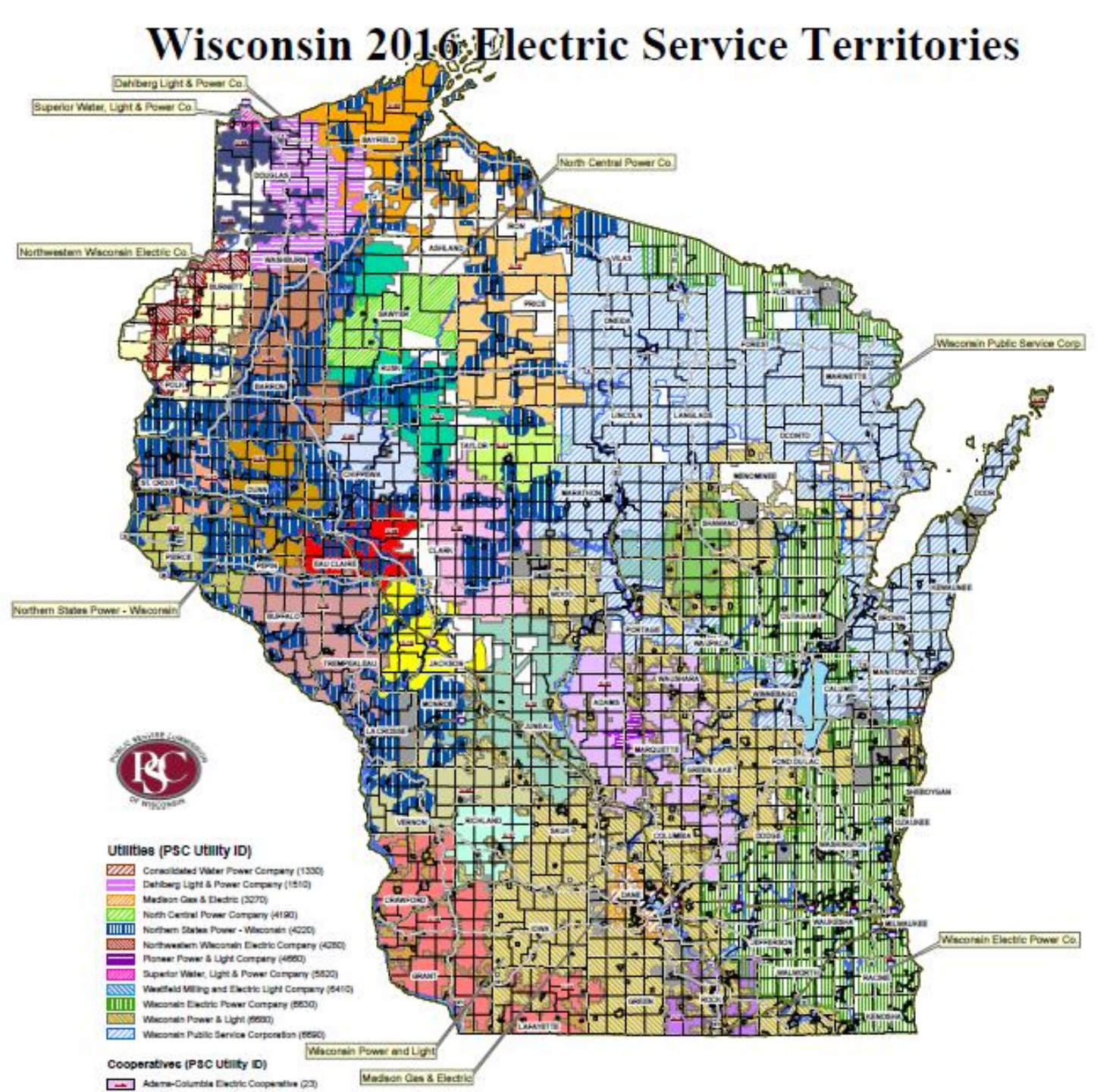
RURAL ELECTRICAL COOPERATIVES



FERC CREATED WHOLESALE MARKETS



WISCONSIN TERRITORY MAP



ASTORIA'S UTILITY BILL

- One-way ledger, - like so not dope.

(30 Days) - 58 Heating Degree Days / 158 Cooling Degree Days

Current Electricity Charges

Residential Electric Service - RG1	30 Days	
Facilities (30 days x $.526020/days)		$15.78
State Low-Income Assistance Fee		$2.39
Energy (491 kWh x $.131110/kWh)		$64.38
Fuel Cost Adjustment (491 kWh x $.000580-/kWh)		$.28 CR
Renewable Grant CR (491 kWh x $.000630-/kWh)		$.31 CR
	Subtotal Electricity Charges	$81.96
Sales Tax ($79.57 x 5.50%)		$4.38
	Total Electricity Charges	**$86.34**

154 Chapter 4

476 SEARS, ROEBUCK & CO., Cheapest Supply House on Earth, Chicago. CATALOGUE No. 111.

OUR

$18.00 Giant Power Heidelberg Electric Belt

Sent on 10 Days' Free Trial

FOR ONLY $18.00 WE OFFER THE GENUINE 80-GAUGE CURRENT HEIDELBERG ALTERNATING, SELF-REGULATING and ADJUSTING ELECTRIC BELT AS THE HIGHEST GRADE, VERY FINEST ELECTRIC BELT EVER MADE, AS THE ONLY SUCCESSFUL ELECTRIC BELT TREATMENT, as the most wonderful relief and cure of all chronic and nervous diseases, all diseases, disorders and weaknesses peculiar to men, NO MATTER FROM WHAT CAUSE OR HOW LONG STANDING.

$18.00 IS OUR LOW PRICE, based on the actual cost to manufacture, for this highest grade electric belt, a superior belt to those usually sold at $30.00 to $50.00. Our $18.00 Giant Power Belt is the result of years of scientific study and experiment, it is the very highest grade, a belt that has all the best features of other electric belts without their drawbacks, defects and discomforts, with exclusive and distinctive advantages not found in other makes. Positively wonderful in its quick cure of all nervous and organic disorders arising from any cause, whether natural weakness, excesses, indiscretions, etc. The nerve building, health giving, vigor restoring current penetrates and permeates the affected parts; every nerve, tissue and fiber responds at once to its healing, vitalizing power; health, strength, superb manliness, youthful vigor is the result.

OUR GIANT POWER 80-gauge Current Genuine Heidelberg Alternating Electric Belt at $18.00 will do you more good in one week than six months of doctoring. The Heidelberg Electric Belt for disorders of the nerves, stomach, liver and kidneys, for weakness, diseased or debilitated condition of the sexual organs from any cause whatever, is worth all the drugs and chemicals, pills, tablets, washes, injections and other remedies put together, its strengthening, healing and vitalizing power is magical—never before equaled.

HAVE YOU DOCTORED? Have you perhaps written to some quack, so-called institute or self styled men's physician, have you tried various so called remedies for your peculiar trouble without success, without getting any help, perhaps not even temporary relief. Perhaps you are discouraged; maybe hopeless. Don't give up. Don't despair. You may yet be cured. The Giant Power Heidelberg Electric Belt is just what you need. Just what you should wear. Send for our Giant Power 80-gauge Current Heidelberg Electric Belt at once, wear it according to directions. In a day you will feel a difference, in two days there will be a marked change for the better, in three days you will experience relief, in a week or two weeks your system will be filled with the grand health giving current, in a month you will be a new man.

OUR GIANT POWER 80-GAUGE HEIDELBERG ELECTRIC BELT AT $18.00 comes complete with the finest stomach attachment and most perfect, comfortable electric sack suspensory ever produced. The lower illustration shows the style of these attachments, but you must see and examine, wear them, to appreciate the comfort and convenience. The suspensory encircles the organ, carries the vitalizing, soothing current direct to these delicate nerves and fibers, strengthens and enlarges this part in a most wonderful manner. The sack suspensory forms part of the circuit. The electric current must traverse every one of the innumerable nerves and fibers. Every wearing brings the current in contact with the organ; every wearing means that part of the organ is traversed through and through with the strengthening, healing current; means a livelihood imparted, a vigor induced, a tone returned, a joy restored that thousands of dollars' worth of medicine and doctors' prescriptions would never give.

DON'T SUFFER IN SILENCE, don't endure in secret. $18.00 will buy our Giant Power 80-Gauge Current Genuine Heidelberg Electric Belt. $18.00 will enable you to face the world anew. $18.00 will bring to you health and strength, vigor, manliness and happiness, a bigger measure for your money, a greater bargain than you could ever possibly secure in any other purchase.

ARE YOU IN DOUBT? Have you tried so called remedies without avail and fear to take advantage of this great offer? Do you hesitate because some unreliable firm or doctor took advantage of you? With us you run no possible risk. Let us send you one of our Genuine Giant Power 80-gauge Heidelberg Electric Belts under the liberal condition of our offer. We will send you the belt, then after ten days' fair trial if you have any reason to be dissatisfied, if you are not greatly benefited, return the belt to us and we will refund your money.

HOW THE 80-GAUGE HEIDELBERG ELECTRIC BELT IS MADE. Every $18.00 80-Gauge Electric Belt of the Heidelberg make is the very finest belt that can be manufactured, made of the highest grade materials money will buy, put together by scientific, skilled mechanics, hand made and finished in every part. The casing for the battery of cells is made of an extra quality very fine selected satin, a grade prepared particularly for this purpose, absolutely non-conducting, lined with a genuine Brighton insulating flannel, and then a layer of close woven non-conducting duck, forming the very best and perfect insulating case possible.

THE BATTERY In our $18.00 Giant Power Heidelberg Electric Belt we furnish the new and genuine Heidelberg battery, consisting of triple cells, producing an 80-gauge current. The battery is made of a secret, highly excitable, metal alloy and composition of silver and copper, a combination producing the quickest, most powerful and lasting current. No battery in any other make can compare in any respect to the Heidelberg. One cell of a Heidelberg battery, with its distinctive triple construction and special composition, has more strength, produces more current, than two cells of the ordinary electric belts usually advertised.

ELECTRODES. Four large and one extra large (five in all) electrodes secure a fine equal distribution of the current to the proper organs and affected parts. The electrodes are large size, splendid conducting surface, extra full and finely silver plated. The four electrodes in back are 2 inches across, the front and largest electrode is 5 inches across. Wonderful in its treatment of diseases of the stomach, liver and kidneys. Carries the life giving electric fluid straight to the affected parts. The big current bearing electrodes can be adjusted for any position, any part, any organ, bringing it in the direct route of the current. For a weak or deranged nervous system the electric treatment has splendid results. It stops losses, repairs waste, gives tone to every tissue and muscle. The whole body feels the good effect. No words can describe the change in health, feeling, vitality, even character, from the result of wearing a genuine Heidelberg Giant Power Electric Belt.

EVERY BELT IS PUT OUT UNDER OUR BINDING GUARANTEE for more current, more power, more and quicker relief than any belt sold at three times the price. Simple, comfortable, efficient. Nothing clumsy about the belt, nothing uncomfortable. No one can tell if you wear it. Complete instructions for use and wear sent with every belt.

CURRENT REGULATOR. Every 80-gauge Heidelberg Electric Belt is provided with our own special and perfect current regulator, a feature imitated (but not successfully) by every electric belt maker in the country. By means of this regulator the current can be instantly adjusted to any strength desired without removing the belt from the body. You can make it mild, medium or strong, just as you like, just as your case requires. No possibility of your receiving an unpleasant shock, no chance to get a current too strong and irritate tender parts. Six different strengths, different degrees of current are possible. A simple movement of a tiny one-inch lever does it. You get just the strength, just the gauge of current required.

THE 80-GAUGE CURRENT is marvelous, really magical in its power. Will cure any case, no matter how obstinate, how long standing. Tones up the system, drives out disease, fortifies the body against cold, against sick attacks of any kind. Perfect in its relief and cure of the peculiar diseases of men. For those sexually weak or impotent or suffering from any trouble of the sexual organs the Giant 80-gauge Belt affords relief when everything else has failed. The stimulating alternating current forces a vigorous circulation of blood into the seminal glands, enlivening them into a healthy glow. They quickly respond to this infusion of energy, dormant nerves wake up and expand, general circulation is produced, youthful vigor displaces the tired out feeling, natural power returns. In most cases of sexual weakness the full power of this belt is required, but a cure is certain. The 80-gauge current absolutely doubles the sexual force and power.

No. 8R3020 OUR 80-GAUGE CURRENT BELT.....$18.00

FOR QUICK RELIEF for an ultimate speedy cure of all weaknesses, no matter from what cause, nothing can equal nothing, whether nothing, drugs or chemicals, approaches the 80-gauge Heidelberg Alternating Current Electric Belt at $18.00. The Heidelberg Electric Belt is most efficient and the cheapest cure possible. Don't let a specialist bleed you. Don't pay $30.00, $40.00 or $50.00 for an electric belt not one-half as good as the Genuine 80-gauge Giant Power Alternating Current Heidelberg Electric Belt at $18.00. Send for one of our $18.00 belts immediately. Throw physic to the dogs. Strengthen and cure yourself at once.

Figure 4.3
The Sears Electric Belt, 1901.

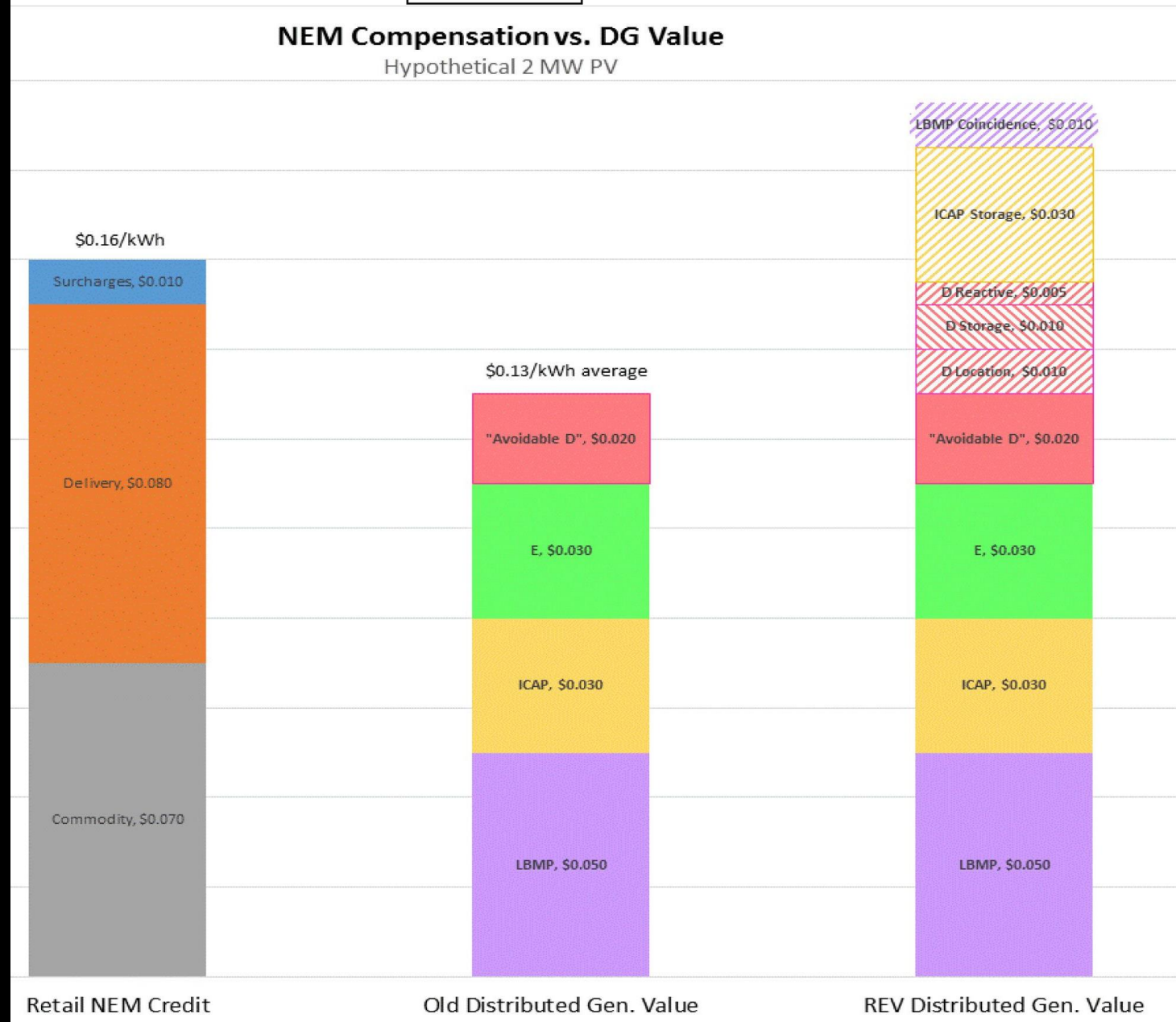
TAKE HOME!

- In the old, "Fordist" mode of production, a centralized utility's revenues were collected from the generation and "sale" of electrical power sufficient to preserve capital accumulation ("profit") based upon the utility's prudent capital expenditures.
- Uni-directional relation ("producer"/"consumer") with a centralized ledger and customer list
- Ledger, production, and ownership are geographically bounded

WHAT'S UP IN NEW YORK?
REFORMING THE ENERGY VISION (REV)

- revising utility revenues streams
- Distributed System Implementation Plan
- modifying low- to moderate-income programs
- **adopting a clean energy standard**
- community net metering
- community choice aggregation
- "resetting" the retail energy service provider market
- establishing a benefit cost analysis framework
- Established a clean energy fund (Green Bank)
- **valuing distributed energy resources**
- utility administered energy efficiency portfolios

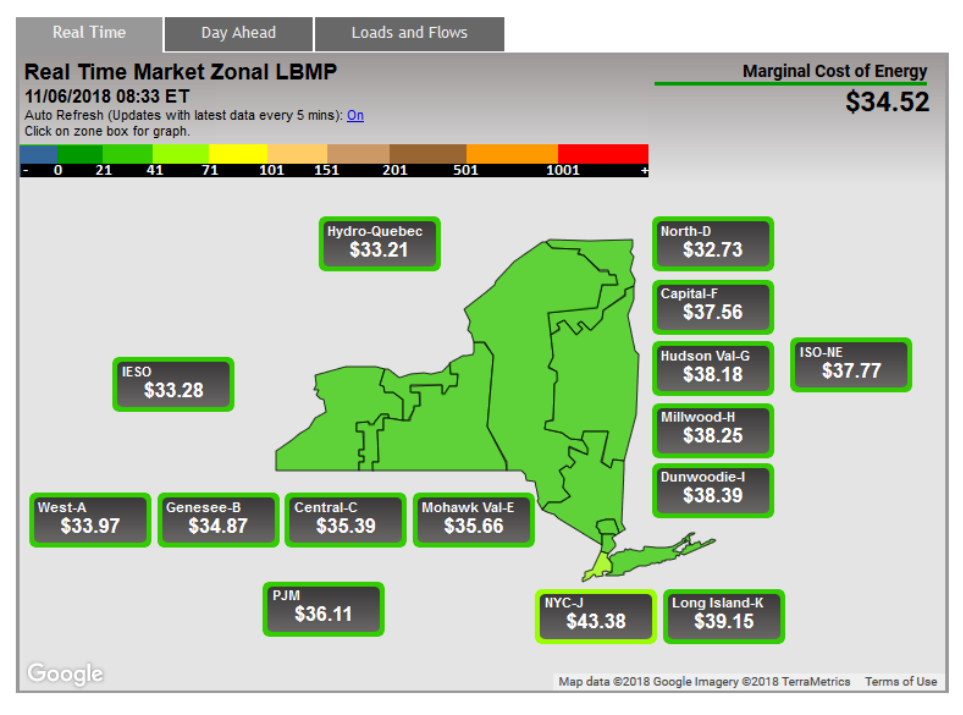
VALUE OF DISTRIBUTED ENERGY RESOURCES (VDER)



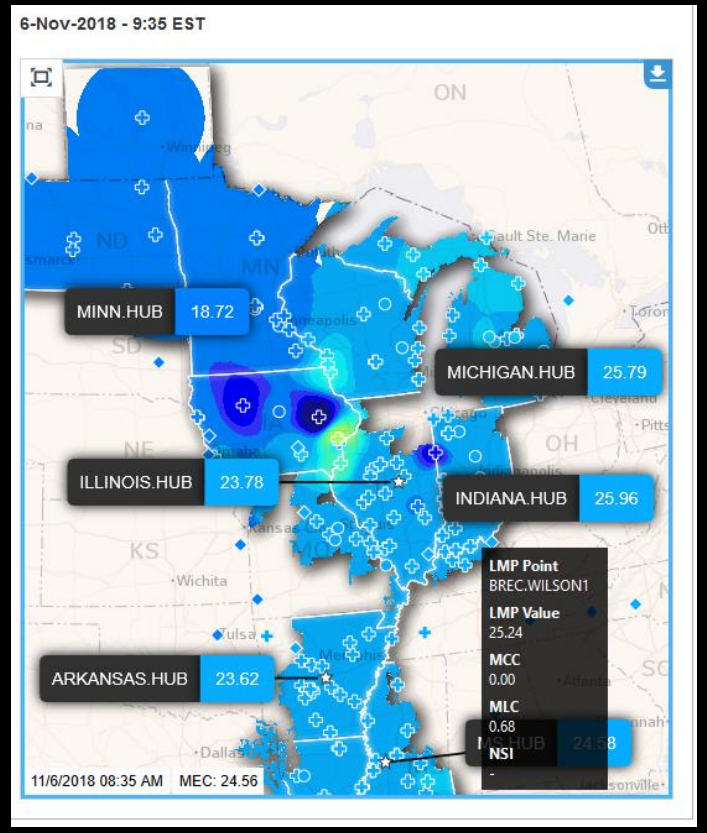
es:
he "retail NEM Credit" column represents compensation NEM provides per kWh.
he "Old Distributed Gen. Value" column represents the potential value that may be provided under NEM price signals, when the kWh and kW
efits are calculated and then expressed on a per kWh basis
he "REV Distributed Gen. Value" represents the potential locational kW and kWh value that could be created if NEM price signals are replaced
more efficient price signals.

LOCATION BASED MARGINAL PRICING

- New York

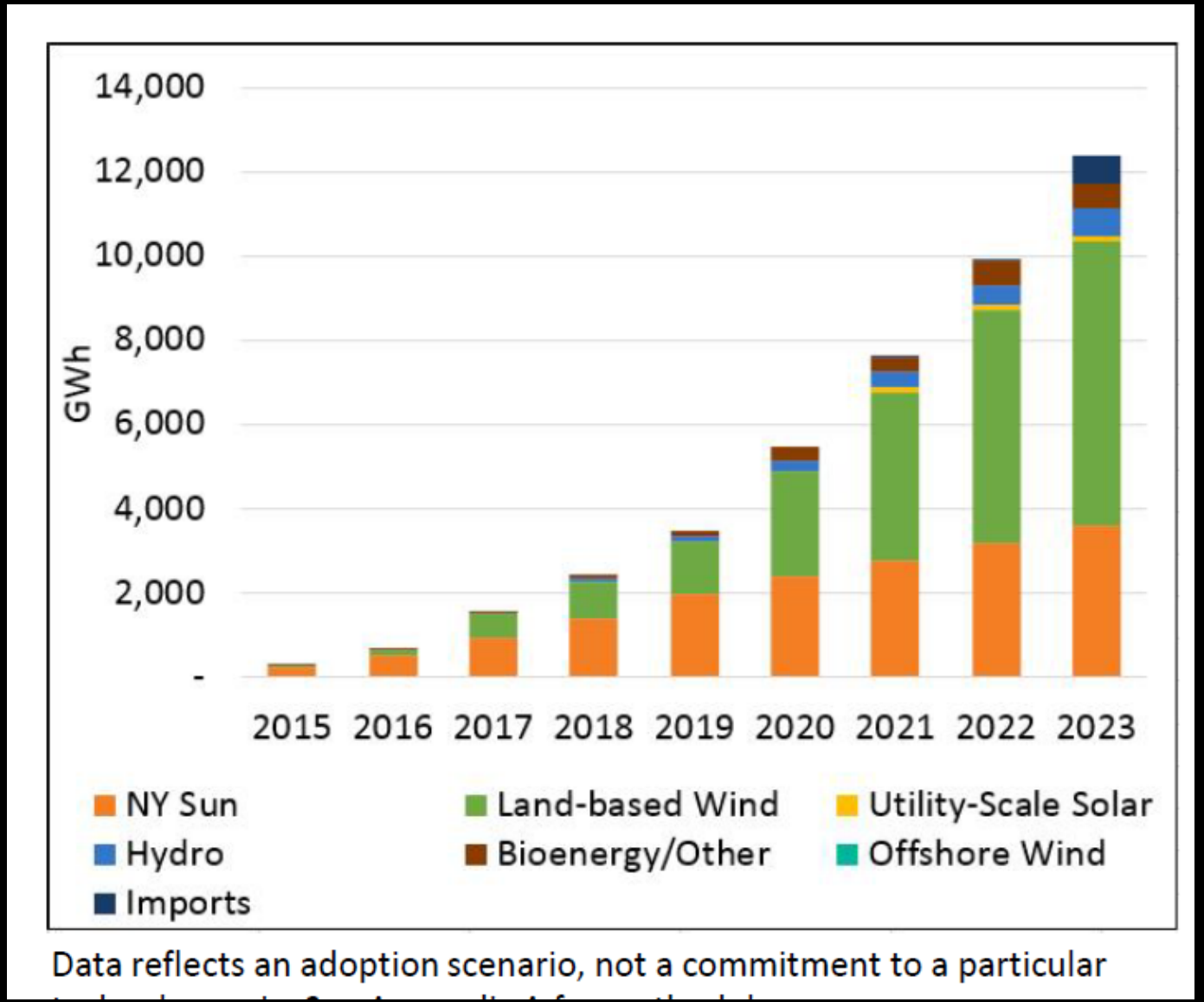


- MISO



CLEAN ENERGY STANDARD

- Renewable Energy Standard – every load-serving entity (LSE) must procure an assigned number of renewable energy credits (RECs, in MWh) and submit them to the New York State Energy and Research Development Authority.



HOW BLOCKCHAIN WERKS

https://www.technologyreview.com/s/610781/in-blockchain-we-trust/

Peer-to-peer decentralized ledger (as compared to a bank, or a utility)

The ledger of transactions is verified by "miners" and the ledger is kept on each "node" in the network

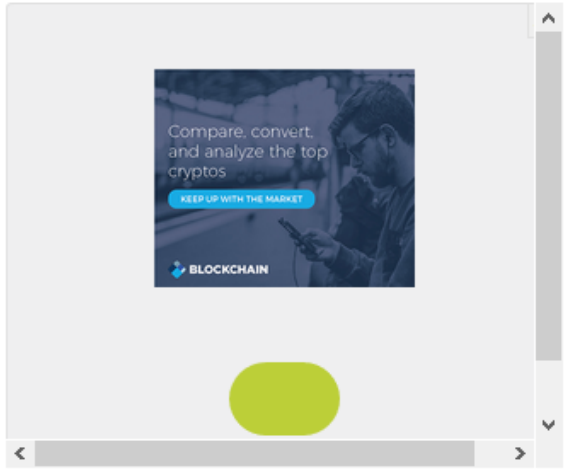
Transactions are stored in "blocks" which are "chained" in a way which makes it impossible (Challenging?, difficult?) to alter past verified transactions, preventing double payment

A BITCOIN BLOCK, YO

Block #549072

Summary	
Number Of Transactions	2950
Output Total	7,700.0516977 BTC
Estimated Transaction Volume	988.57945843 BTC
Transaction Fees	0.21311036 BTC
Height	549072 (Main Chain)
Timestamp	2018-11-07 01:05:40
Received Time	2018-11-07 01:05:40
Relayed By	ViaBTC
Difficulty	7,184,404,942,701.79
Bits	388443538
Size	1264.037 kB
Weight	3992.534 kWU
Version	0x20000000
Nonce	4072827148
Block Reward	12.5 BTC

Hashes	
Hash	00000000000000000140d1b5083206db695430f846b90be2e09877f55e3f2fa
Previous Block	00000000000000000018649424e7ed6effb69397181b4efef71a5979f2d3c60c
Next Block(s)	
Merkle Root	ac93d7323758375bad74cf0960decc00933508b8aebbca81ce59eb34d95ebc25



A DOGECOIN BLOCK, WOOF!

AMOUNT TRANSACTED	FEES	RECEIVED	CONFIRMATIONS
10,700.16865001 DOGE	1.0 DOGE	2 minutes ago	1/6

Advanced Details

Block Hash	47703d3a78403efa39f8f2284dcbd13d51ef2011faea36dc5548ea175e366d8d
Block Height	2,463,299
Transaction Index	3 (permalink)
Size	333 bytes
Lock Time	
Version	1

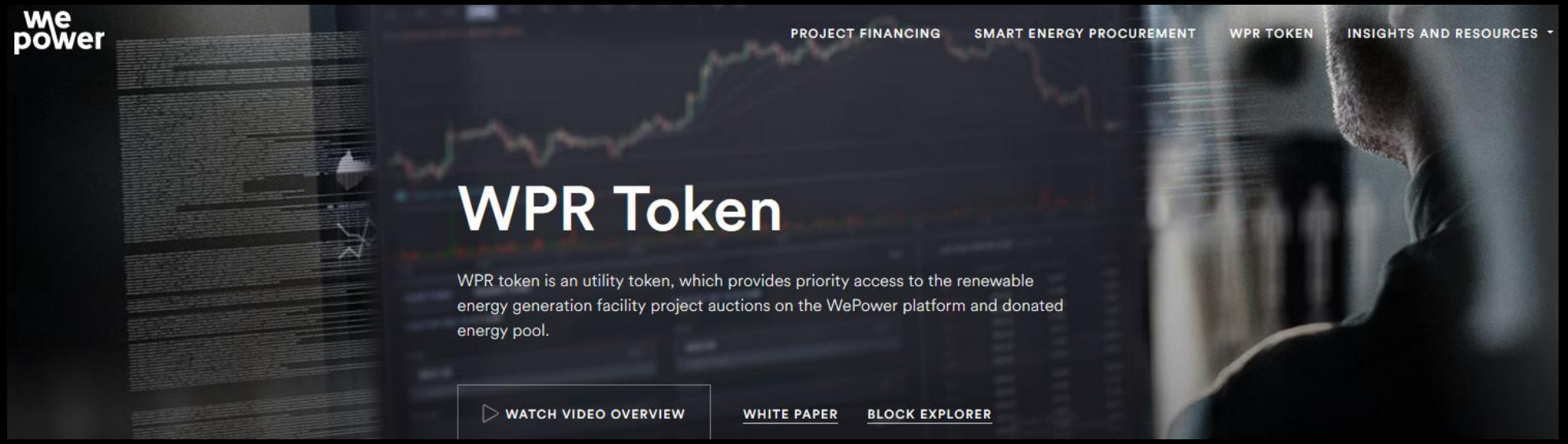
</> API Call API Docs

EXAMPLES OF DIGITIZATION

- Ordinary Data Collection, just tons more of it
  - New York Public Authority and GE

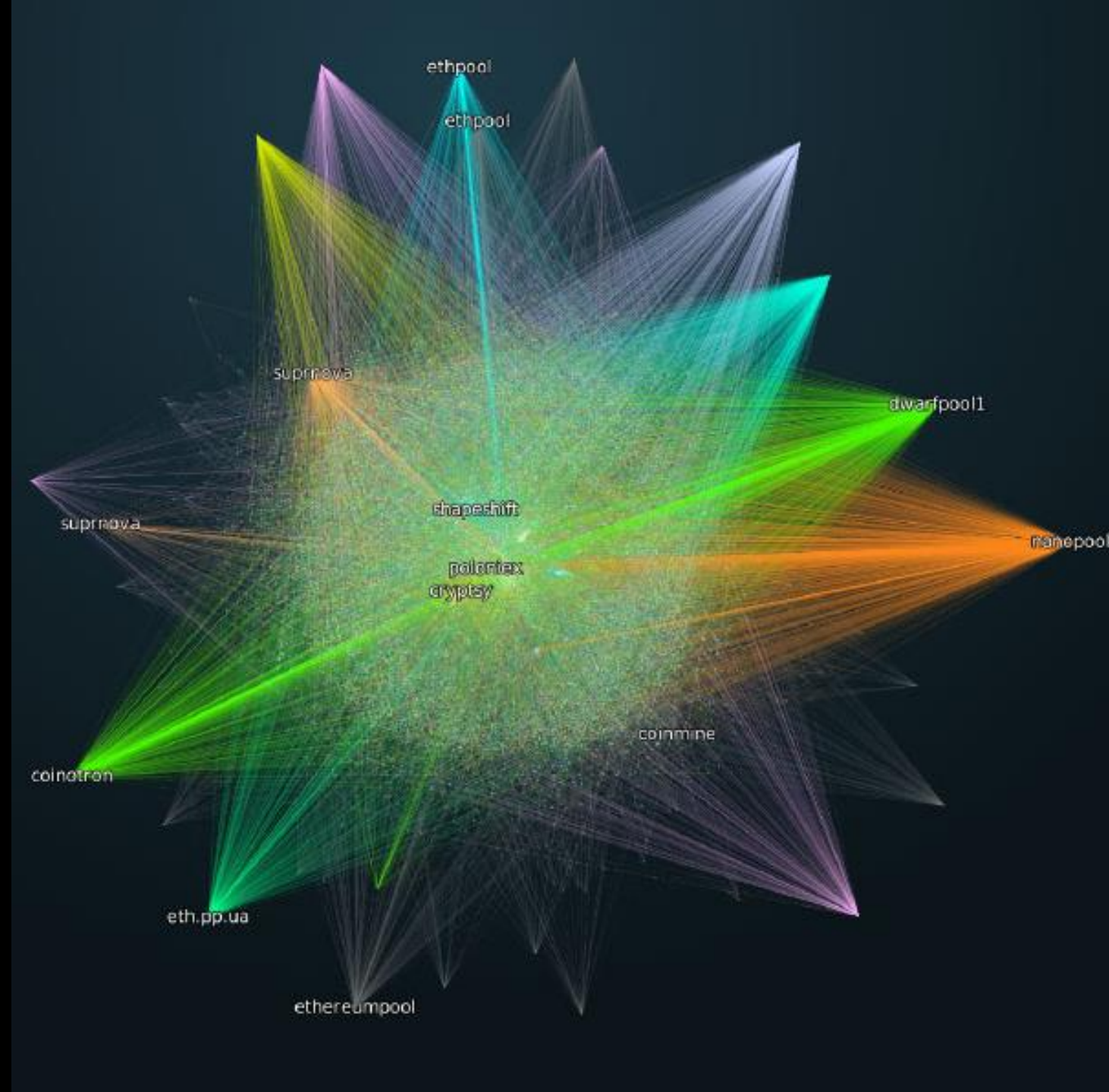
DIGITIZATION VIA BLOCKCHAIN

- Renewable Energy Credits
- new currency representing something other than what fiat currency represents (like power!)
- Ex: WePower's Initial Coin Offering ($40 million, about 29,300 contributors)



DISTRIBUTED ENERGY RESOURCE

- Coordinate the “values” produced by the differing contributors to the decentralized grid
- Electron’s ‘ethr’ R Package: https://github.com/bsdstudios/ethr



http://www.electron.org.uk/index.html#read_more

CRITIQUES AND QUERIES: SMART CITY, OR NOT-SMART CITY?

- Takes energy to "mine" cryptocurrency
- Blockchain is, like, so slow . . .
- Still need access to the central ledger, i.e., an order from the public service commission changing the monopoly utility's accounting practices
- It's electric, boogie-woogie
- Just 4 mining "pools" control greater than 50% of mining capacity on Bitcoin
- Where's the capital accumulation?