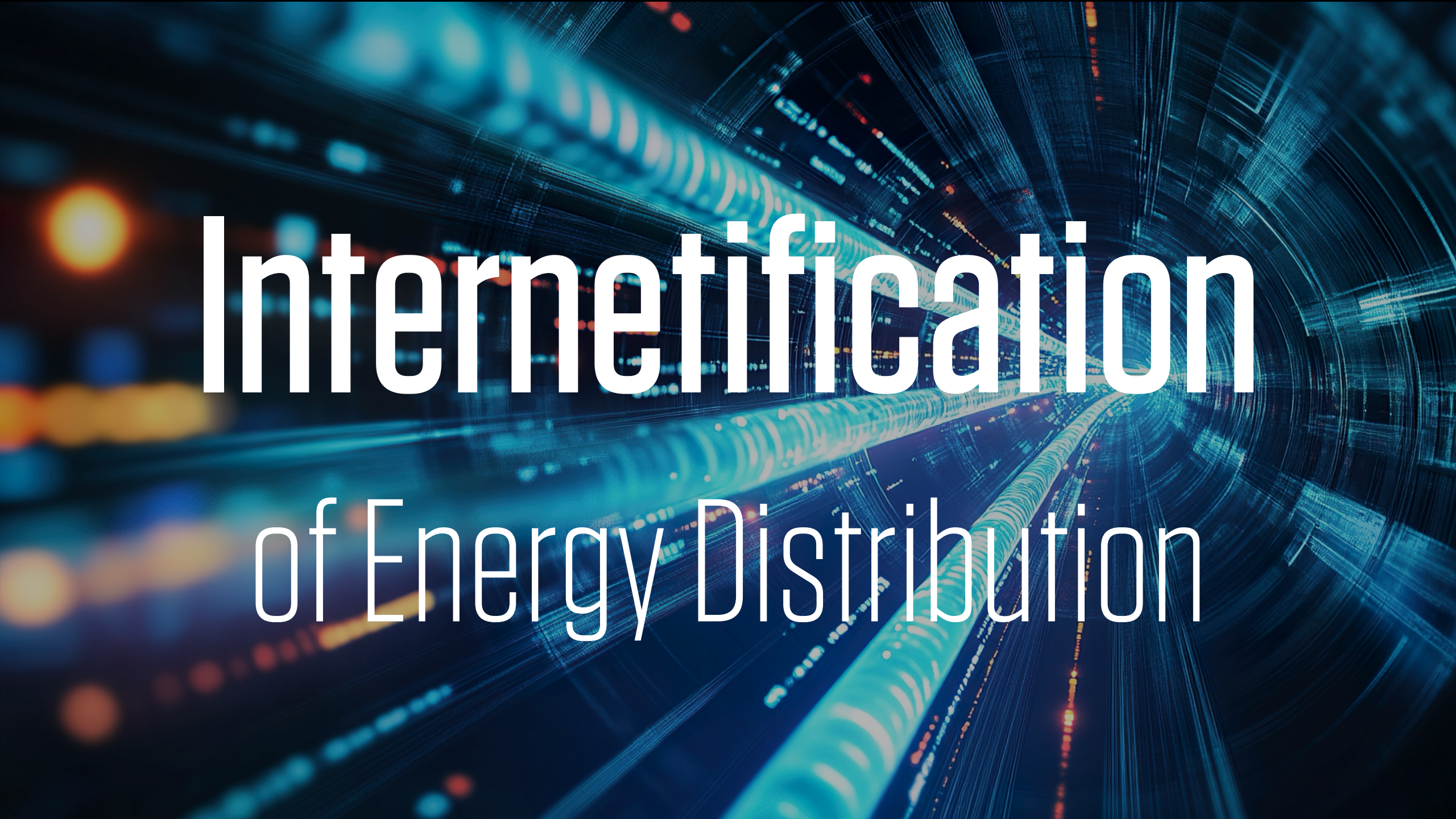

Internetification
of Energy Distribution

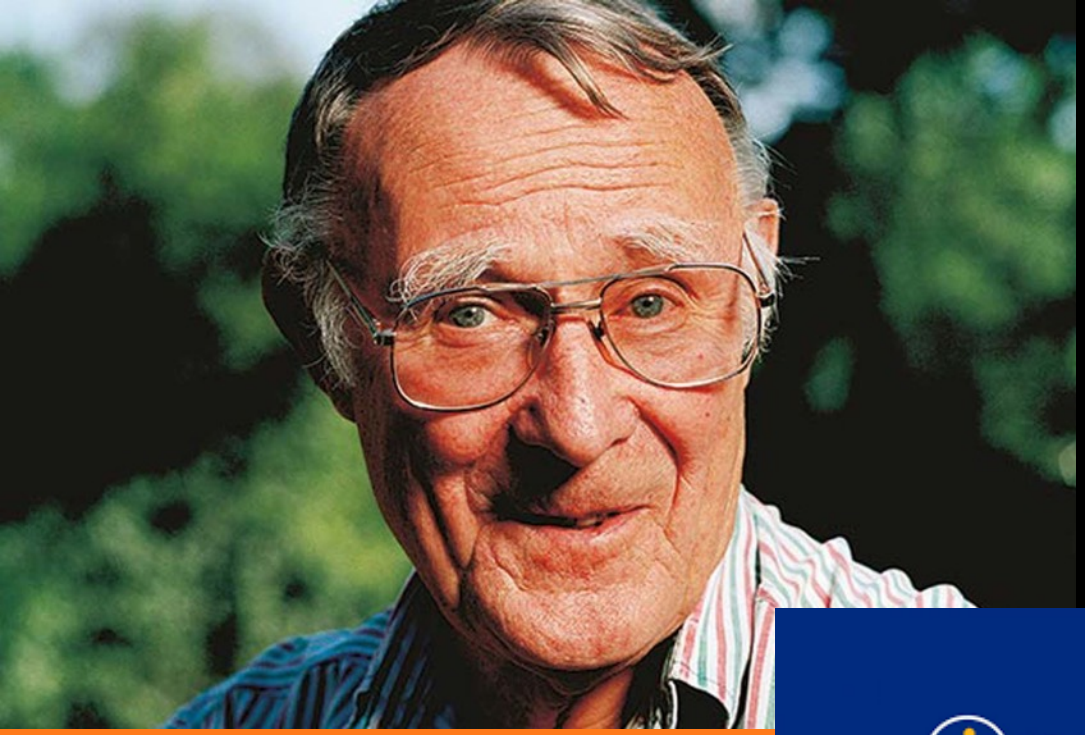


Energy is Becoming a Network Business

ViaEuropa is the world's first EnergyNet Operator, turning buildings into connected local energy markets that we call **short grids**.

Starting in Lund. Built on 25 years of open-network operating experience.







investor

FRAMFAB







Våra bilar Köpa Äga Elbilar Om oss VOLVO Logga in

The new and electric Volvo EX60 is changing the game: join us for the global reveal

Watch later Share

EX60

Watch on YouTube


U.S. Robotics
56K Faxmodem
RD
SD
PWR
CD

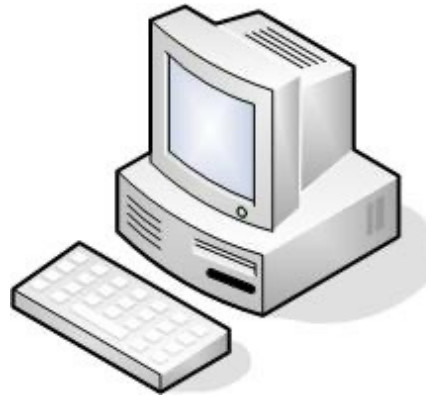







doro
1234567
M1
M2
R
C
1
2 ABC
3 DEF
4 GHI
5 JKL
6 MNO
7 PQRS
8 TUV
9 WXYZ
*
0
#
doro







Networked Readiness Index 2012, 1-7 (best)

Description Networked Readiness Index (Framework as of 2012)

Source World Economic Forum, [i]The Global Information Technology Report 2012[i] Dataset Networked Rea

R...	Entity	Value	.	Period	Series (tree)
1	Sweden	5.94			Networked R
2	Singapore	5.86			Networked R
3	Finland	5.81			Networked R
4	Denmark	5.70			Networked R
5	Switzerland	5.61			Networked R
6	Netherlands	5.60			Networked R
7	Norway	5.59			Networked R
8	United States	5.56			Networked R
9	Canada	5.51			Networked R
10	United Kingdom				Networked R
11	Taiwan, China				Networked R
12	Korea, Rep.				Networked R
13	Hong Kong S...				Networked R
14	New Zealand				Networked R
15	Iceland				Networked R
16	Germany				Networked R
17	Australia				Networked R
18	Japan				Networked R
19	Austria				Ne Networked R
20	Israel				Networked R

We worked with **seven of the eight first countries** on the NRI (not Singapore)

Bredbandsbolaget: Pioneered national-scale broadband; designed, built, and operated infrastructure that set the **new price / performance standard.**

10/10 Mpbs for **200 SEK / month** in **1998**

Telia Company



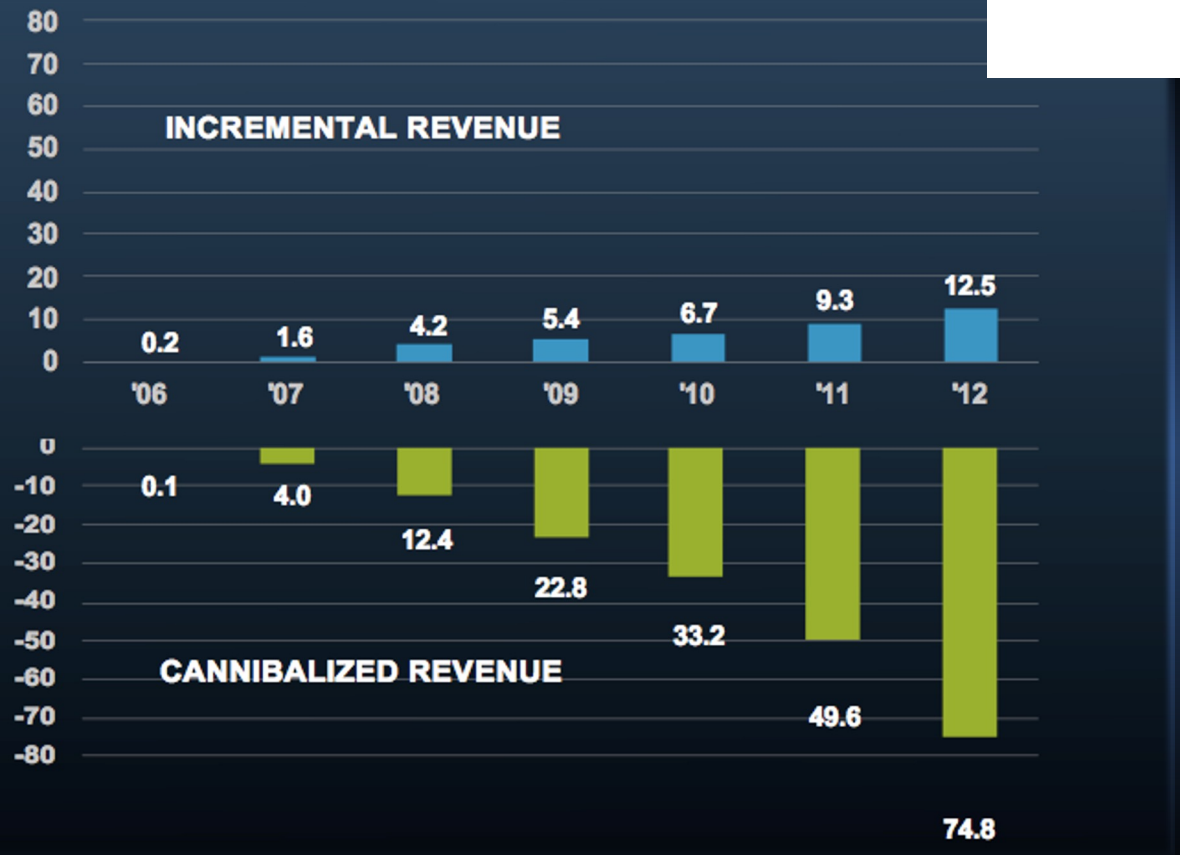
Telia: after ISDN & ADSL made a quick pivot to the **new price / performance standard.**

2014 1 million homes on fiber
2026 closing POTS **only on Mobile / Fiber**

Challenges for traditional Telecom Operators

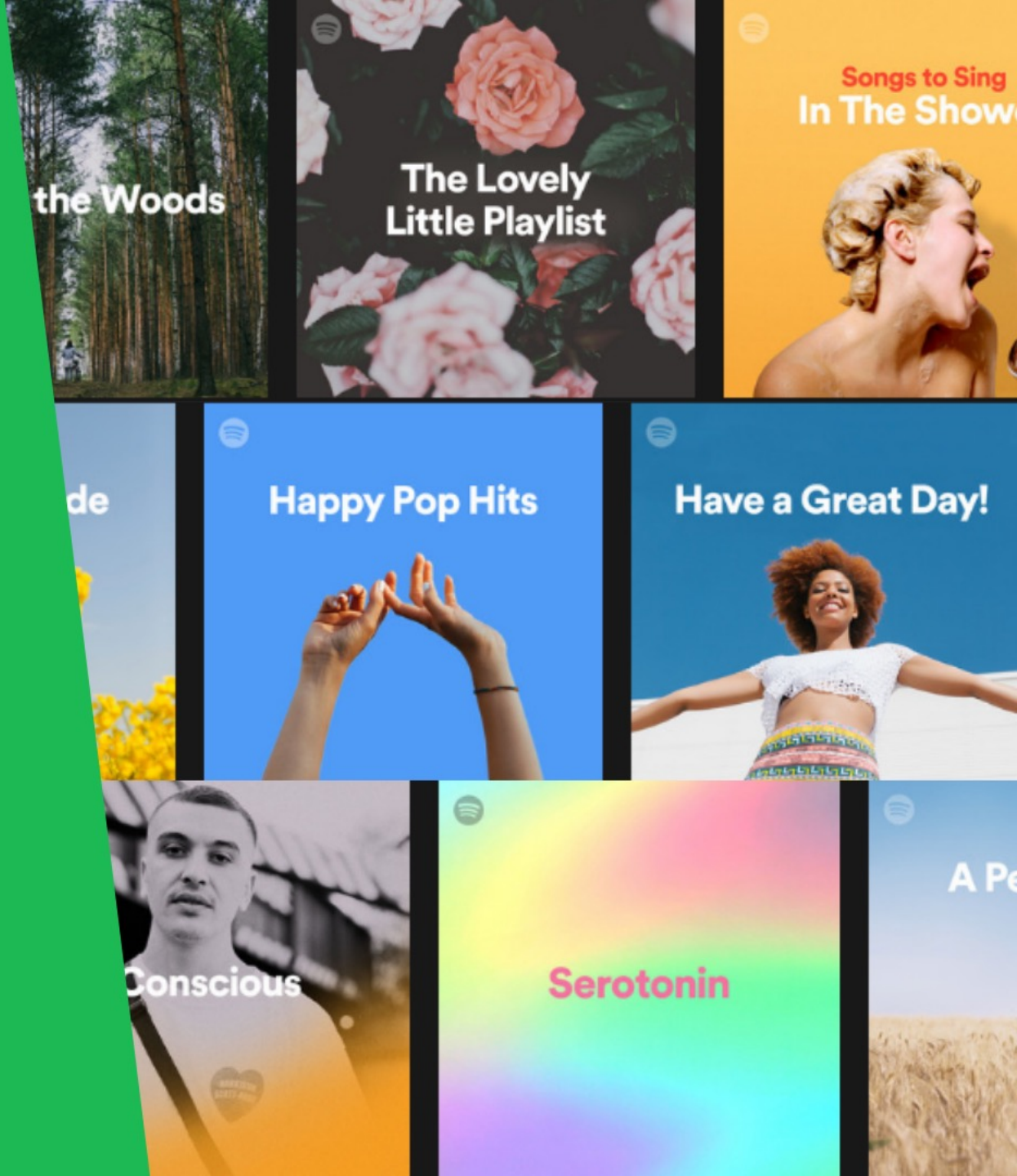
Constant pressure on revenues





© 2011 ViaEuropa AB. All rights reserved.

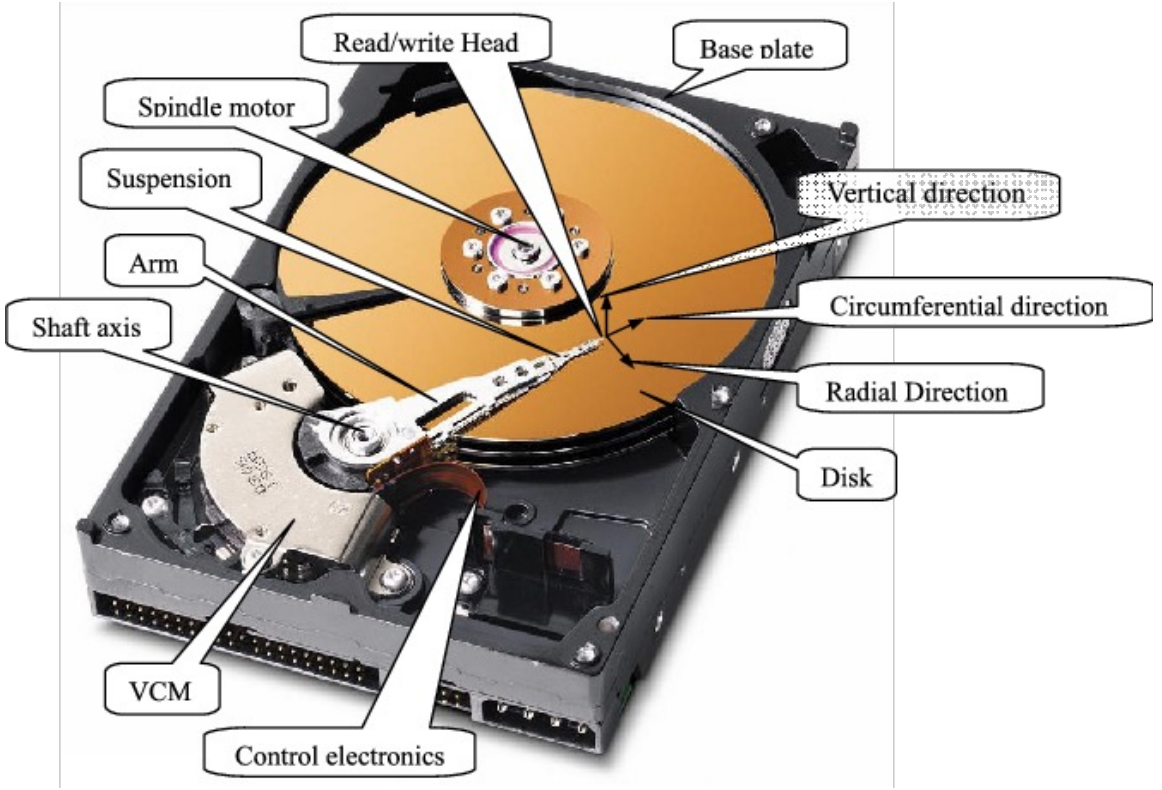
Spotify®


the Woods
The Lovely
Little Playlist
Songs to Sing
In The Show
de
Happy Pop Hits
Have a Great Day!
Conscious
Serotonin
A Pe

Price Performance drivers [Architecture]

Better drive solution (adding complexity & cost)

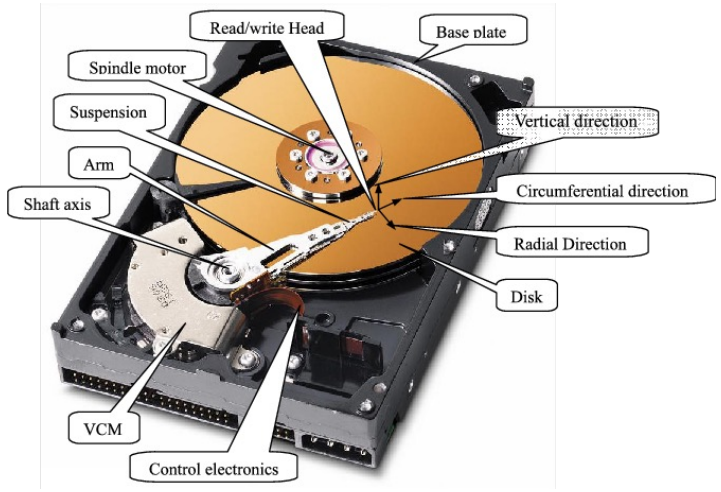
99%	100 USD
99,9%	1000 USD
99.99%	10 000 USD
99.999%	100 000 USD
99.9999%	1 000 000 USD



Better drive vs RAID

1000 000 USD 99.9999% 300 USD

~~NA~~ 99.99999999999% 600 USD





Better drive vs RAID

99.9999999999 %

600 USD

1 second of down time

in 31 700 years

Age of human civilization : ~5000 years



Better drive vs RAID

99.999999999999999%

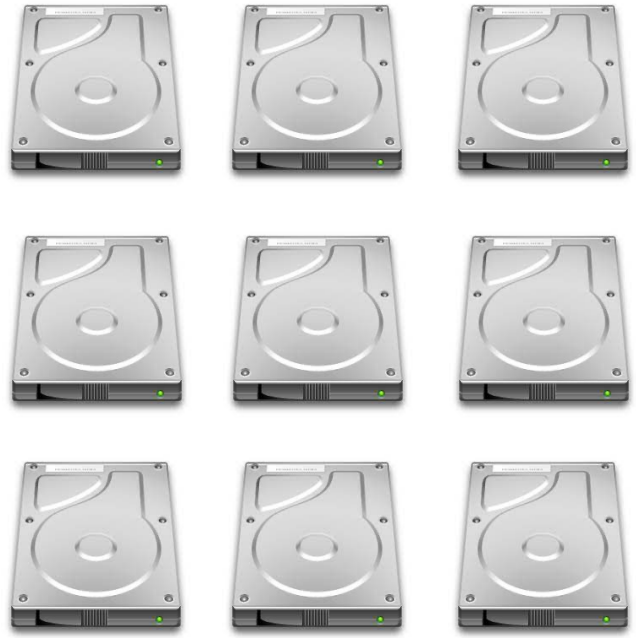
900

USD

1 second of down time

in 31,7 billion years

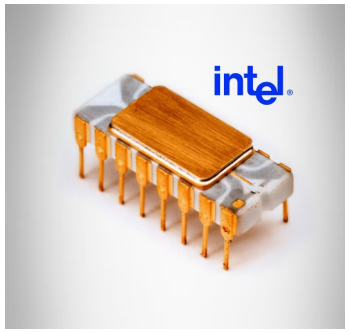
Age of the universe: ~13.8 billion years



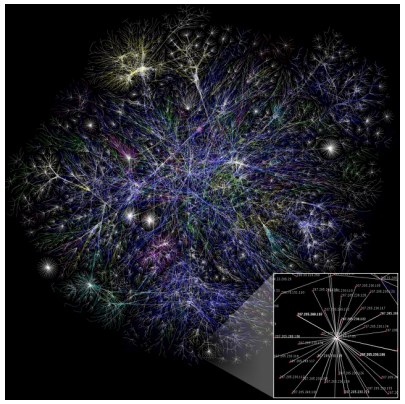
Few / Large / Expensive

Many / Small / Cheap

Electrotech

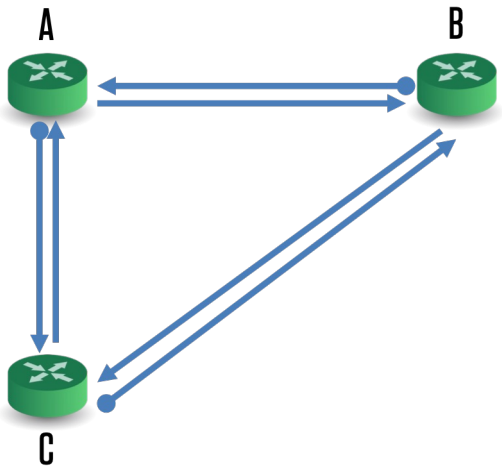

intel


IBM






DEFA
READY
RFID


A
B
C

Digitalisation

Electrification

First gridlock transmission blocking green energy

The old grid upgrade is a trillions of dollars problem. And even if funded it would take decades.

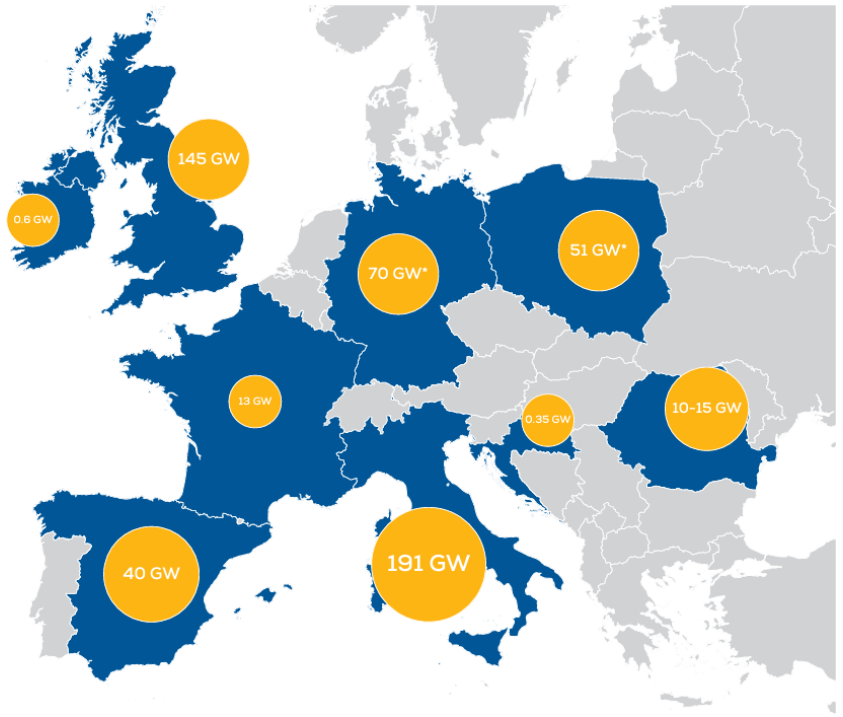


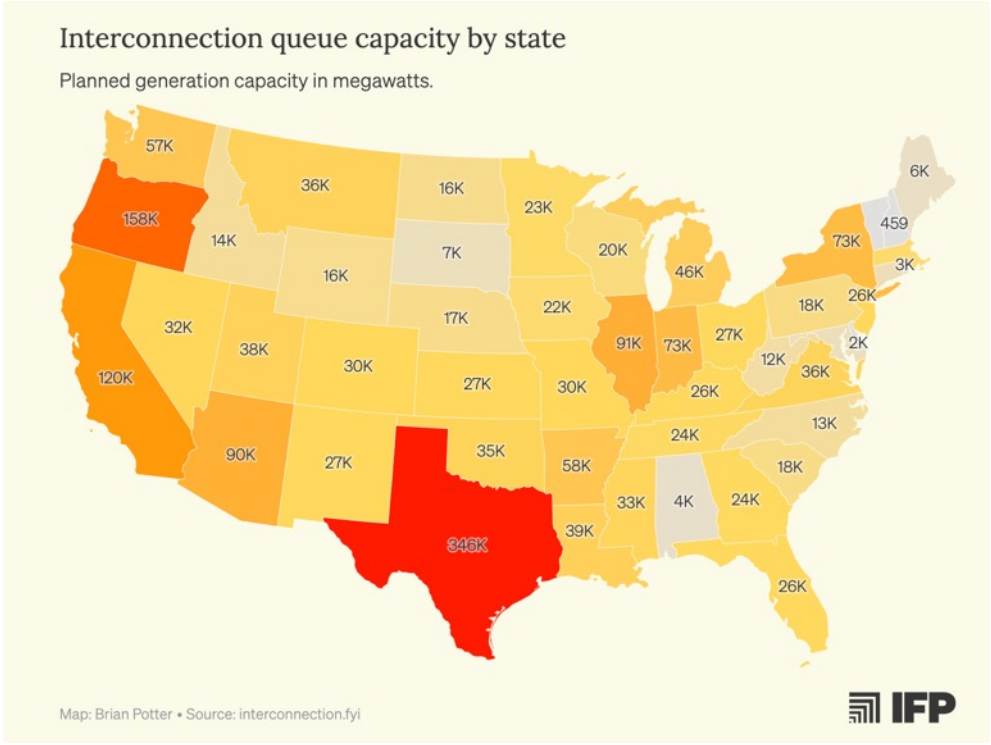


Technology Quarterly | The ultimate supply chains

The electric grid is about to be transforme

The technological and regulatory requirements will be immense, writes Hal Hodson





First gridlock transmission blocking green energy

The old grid upgrade is a trillions of dollars problem. And even if funded it would take decades.





Is there a risk for the old grid (POGS) to become a dead end?

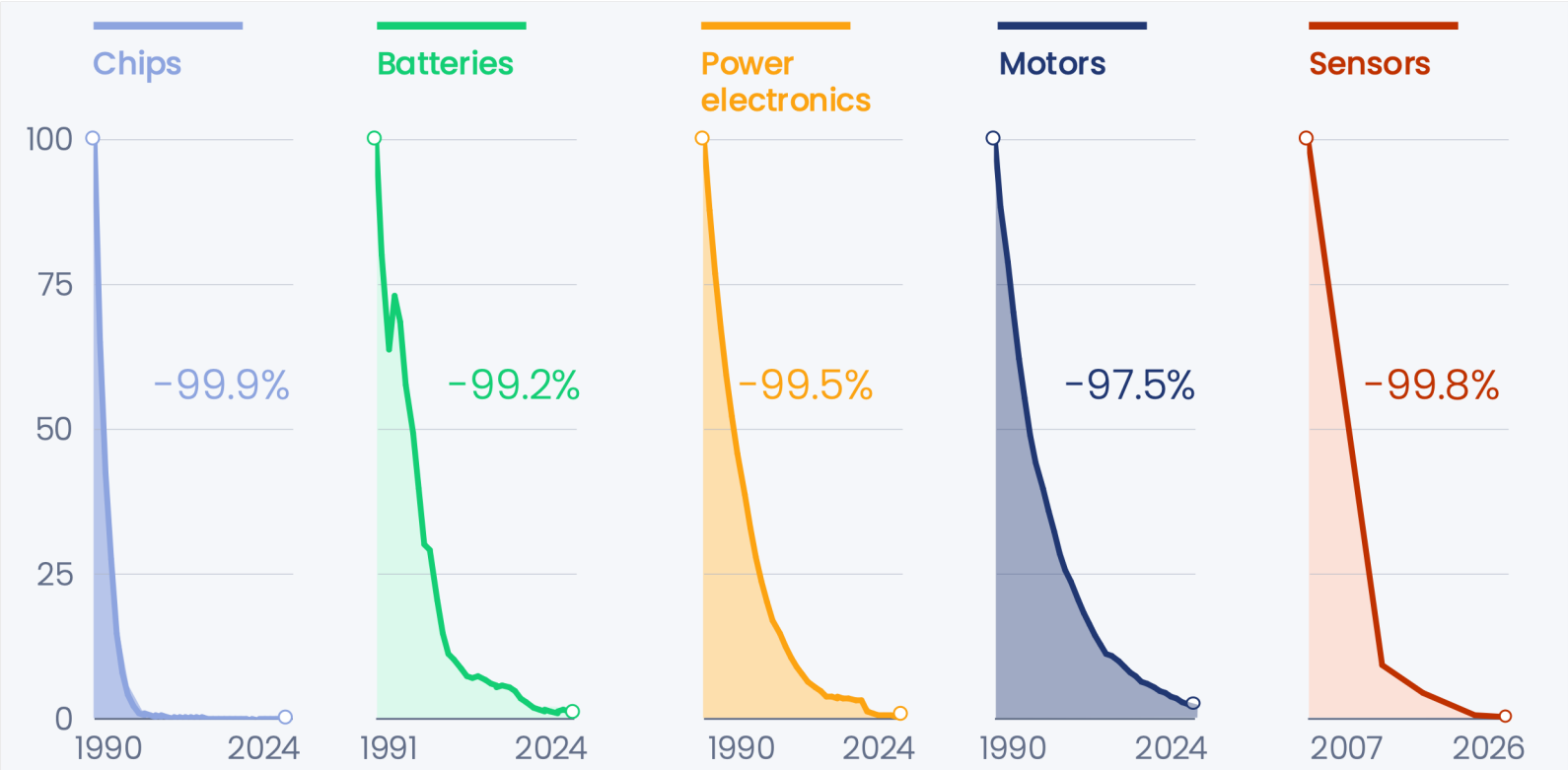
- Increasing cost
- Reduced reliability
- Connection queues

One tech stack, one flywheel, two revolutions

Infotech and electrotech push each other's costs down and capabilities up

The electric component stack

Price, first year = 100



Lower prices for each

Lower prices reduce final cost of infotech and electrotech, boosting sales

More collective volume

Both infotech and electrotech drive up demand and therefore scale up supply, lowering production cost

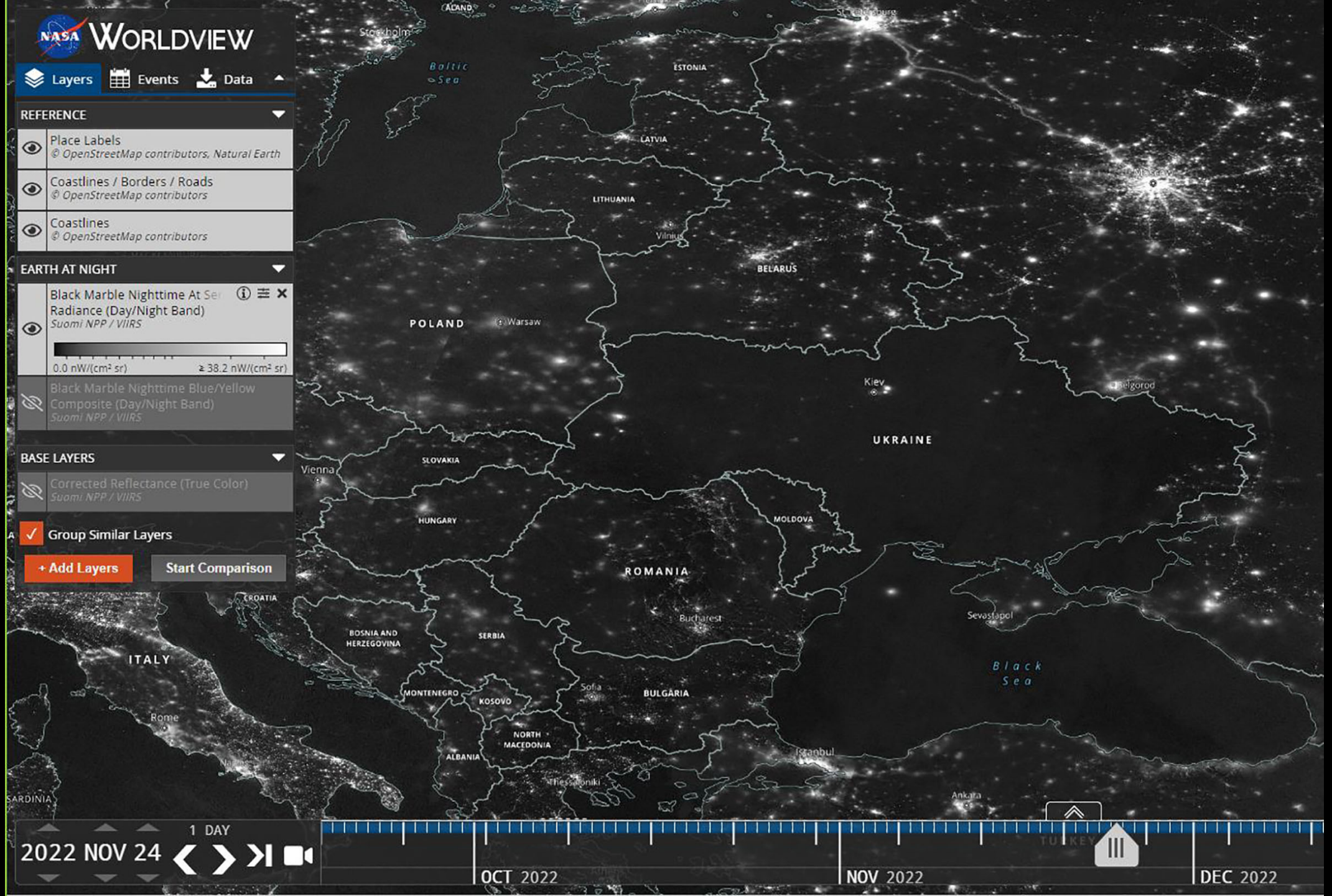
Example electrotech and infotech using the five components

- Laptop & PC
- Smartphone
- AI server
- Solar system
- Electric car
- Grid battery

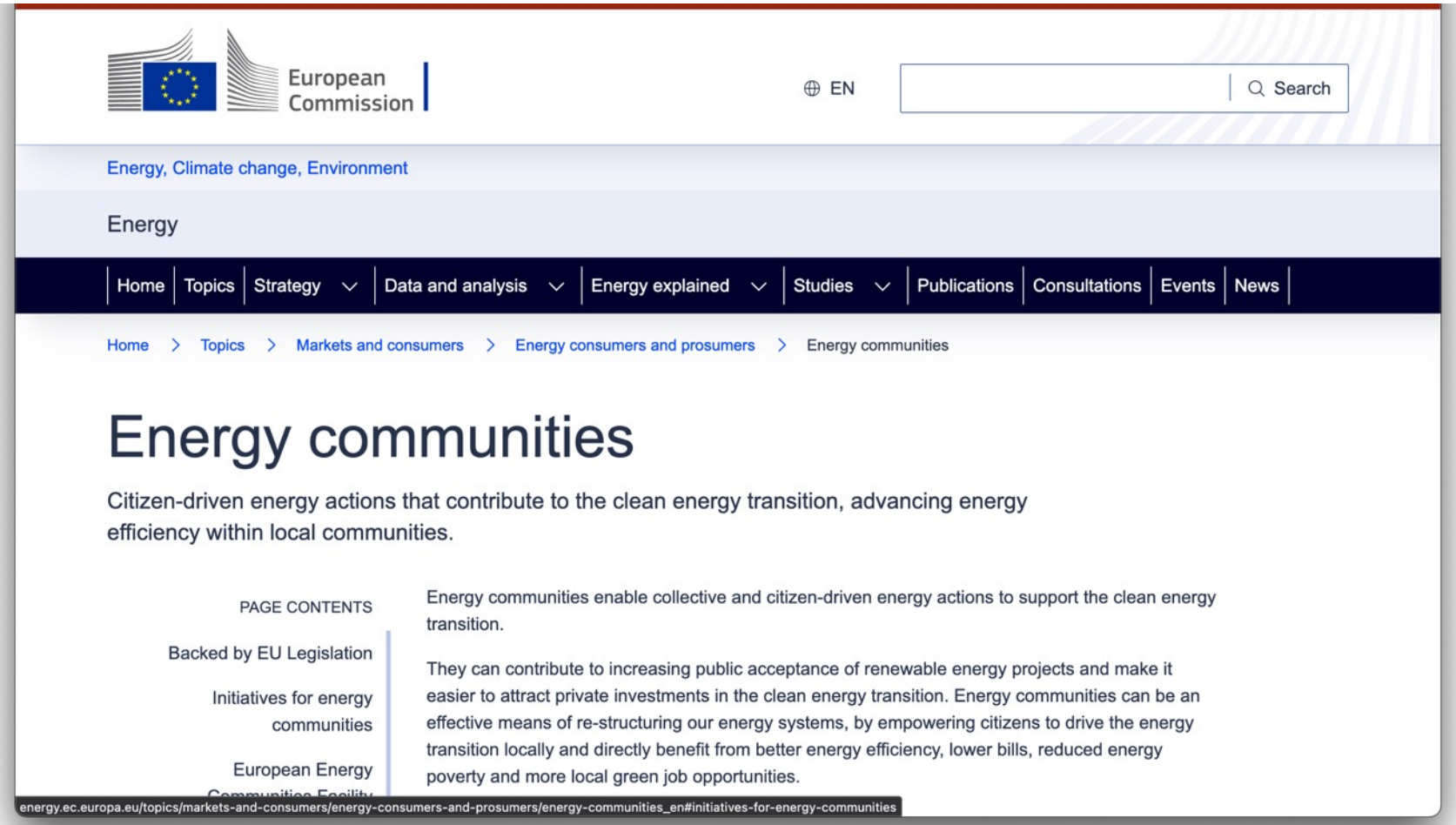
Sources: Not Boring (The Electric Slide); Our World in Data; Velodyne; Hesai; Thunder Said Energy; Ember analysis • Note: based on the following units: chips $/DMIPS, batteries $/kWh, power electronics $/kW, motors $/kW, sensors $/LIDAR unit.

EMBER




NASA WORLDVIEW
Layers
Events
Data
REFERENCE
Place Labels
© OpenStreetMap contributors, Natural Earth
Coastlines / Borders / Roads
© OpenStreetMap contributors
Coastlines
© OpenStreetMap contributors
EARTH AT NIGHT
Black Marble Nighttime At Se
Radiance (Day/Night Band)
Suomi NPP / VIIRS
0.0 nW/(cm² sr)
≥ 38.2 nW/(cm² sr)
Black Marble Nighttime Blue/Yellow Composite (Day/Night Band)
Suomi NPP / VIIRS
BASE LAYERS
Corrected Reflectance (True Color)
Suomi NPP / VIIRS
Group Similar Layers
+ Add Layers
Start Comparison
1 DAY
2022 NOV 24
OCT 2022
NOV 2022
DEC 2022
Baltic Sea
ESTONIA
LATVIA
LITHUANIA
Vilnius
BELARUS
POLAND
Warsaw
Kiev
UKRAINE
SLOVAKIA
Vienna
HUNGARY
MOLDOVA
ROMANIA
Bucharest
Sevastopol
Black Sea
CROATIA
BOSNIA AND HERZEGOVINA
SERBIA
ITALY
Rome
MONTENEGRO
KOSOVO
Sofia
BULGARIA
NORTH MACEDONIA
ALBANIA
Istanbul
Ankara
SARDINIA

For the first time in a 100 years, it now legal to build parallel electrical grids in all EU countries



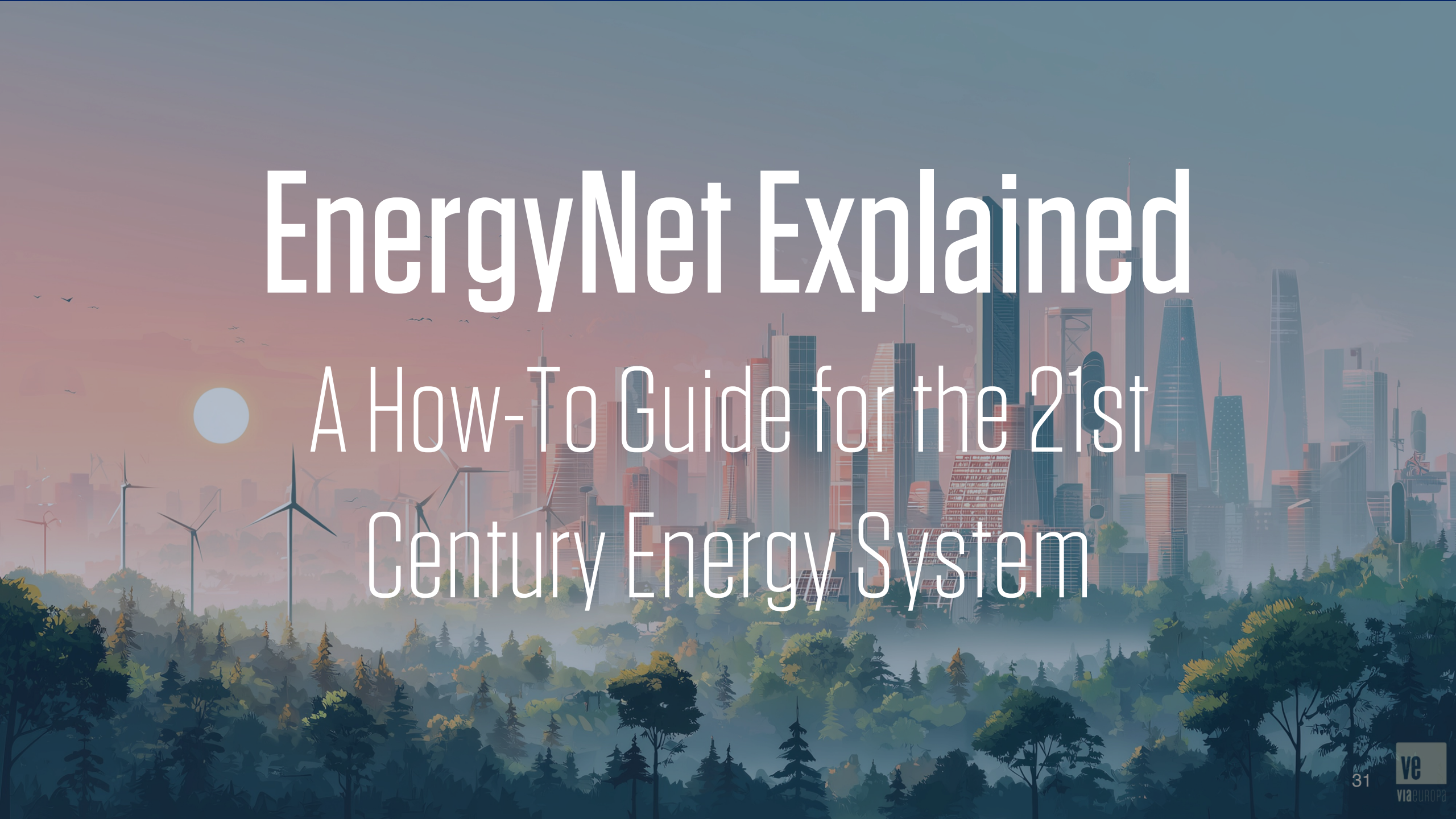
"Freedom Cables"

- ✓ Distribution Tech (AC/DC)
- ✓ Set price for transport
- ✓ Set your price for power

Because of this deregulation EU could become a leader in **new and disruptive energy distribution systems**.

EnergyNet Explained

A How-To Guide for the 21st Century Energy System



EnergyNet Explained: Internetification of Energy Distribution
A How-To Guide for a 21st-century Energy System

Abstract

Building on lessons from telecom's shift from a centralized, circuit-switched phone system to decentralized, packet-switched data networks. EnergyNet utilizes:

(i) an Energy Router that enforces galvanic separation and software-defined energy flows over a DC backplane;

(ii) Energy Local/Wide Area Networks (ELAN/EWAN), DC microgrids that interconnect by policy via an open Energy Protocol (EP); and

(iii) a control plane comprising the Energy Router Operating System (EROS) and EP Server, managed at operator scale through an Energy Network Management System (ENMS).



EnergyNet Explained: Internetification of Energy Distribution
The podcast version



Quantifying EnergyNet performance: a simulation-based framework for decentralized energy networks

Max Collins, Jonas Birgersson, Marc A. Weiss, Jimmy Chen, Marc Z. Jacobson, Newsha K. Ajami, Daniel Kammen, Tomas Kåberger, Franklin Carrero-Martínez, Joakim Wernberg, Michael Menser, Henrik Ny, Lou Riordan, Jill G. Ferguson



Abstract

Modern power systems are increasingly exposed to severe disturbances caused by extreme weather, infrastructure failures, and geopolitical conflicts. Conventional power systems rely on interconnected transmission and distribution infrastructure to connect generation and consumers, and failures of this infrastructure can disconnect large groups of consumers from their energy supply until service is restored. At the same time, increasing amounts of local generation, storage, and controllable loads are being deployed throughout the power system, creating new possibilities for how electrical energy systems can be organized and operated.

EnergyNet has been proposed as a decentralized, software-defined energy architecture based on interconnected power electronic Energy Routers. Each router coordinates local loads, generation, storage, and grid connections, while bidirectional Energy Links enable energy exchange between routers. Energy exchange is coordinated through the Energy Protocol, allowing routers to communicate energy needs and availability and establish energy transfer across the network. EnergyNet can operate together with the conventional grid, independently from it, or across combinations of grid-connected and isolated regions.


EnergyNet is not
a product, a brand
or a company.



Outcome 01

Resilience Without Single Points of Failure

Low fixed cost for clean energy





Unlocking the **EV Promise**

Unlimited Mobility



The 500 kg battery is visible. The 28 tonnes of CO_2 are not.

Illustrative petrol car: 6.0 L/100 km over 200,000 km. Tailpipe CO_2 only.

THE OBJECT WE SEE



0.5 t

durable battery asset

Materials remain in the system and can be reused or recycled.

THE OUTPUT WE DO NOT SEE

28.2 t CO_2

≈ 14 two-tonne cars



Each car silhouette = 2 tonnes of CO_2

≈ 56 battery masses

6.0 L/100 km	×	**200,000 km**	=	**12,000 L petrol**	×	**2.35 kg CO_2/L**	=	**28.2 t CO_2**

Most of the added mass is oxygen from the air.

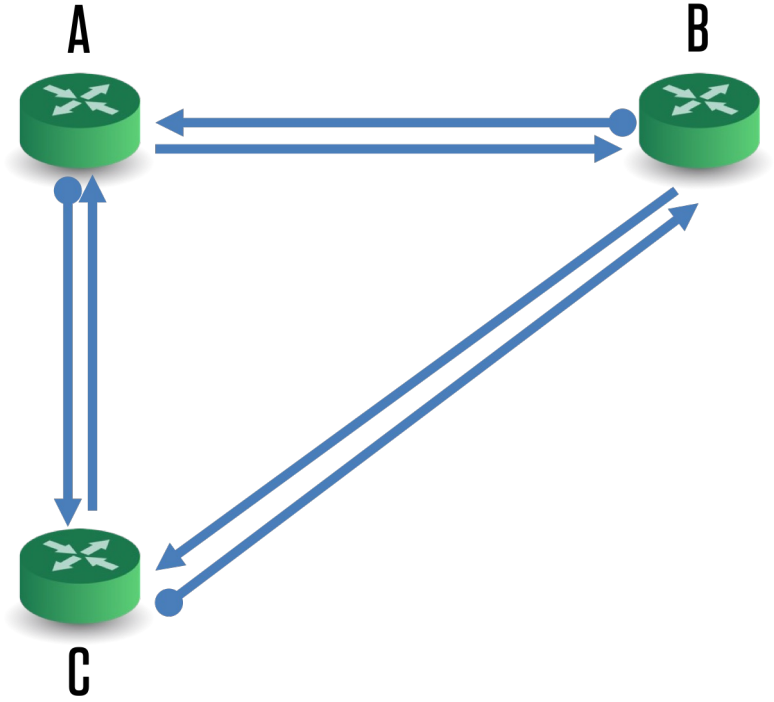
Lifecycle check: IEA finds a medium BEV sold in 2023 produces about half the lifecycle emissions of an equivalent ICEV globally.

Sources: US EPA combustion factor; IEA Global EV Outlook 2024, p. 157.

Innovation the energy protocol

The Energy Protocol (EP)

Inspired by the Internet architecture distributed and independent networks that can function as standalone but will benefit greatly from being interconnected with as many compatible networks as possible. EP will include similar concept to routing but for Energy Sharing. It also simplify EnergyNet operation concepts such as Software Defined Energy Networks.



ENERGYNET TASK FORCE

A Protocol for Packet Network Intercommunication

VINTON G. CERF AND ROBERT E. KAHN,
MEMBER, IEEE

Abstract — A protocol that supports the sharing of resources that exist in different packet switching networks is presented. The protocol provides for variation in individual network packet sizes, transmission failures, sequencing, flow control, end-to-end error checking, and the creation and destruction of logical process-to-process connections. Some implementation issues are considered, and problems such as internetwork routing, accounting, and timeouts are exposed.

INTRODUCTION

IN THE LAST few years considerable effort has been expended on the design and implementation of packet switching networks [1]-[7],[14],[17]. A principle reason for developing such networks has been to facilitate the sharing of computer resources. A packet communication network includes a transportation mechanism for delivering data between computers or between computers and terminals. To make the data meaningful, computer and terminals share a common protocol (i.e, a set of agreed upon

of one or more *packet switches*, and a collection of communication media that interconnect the packet switches. Within each HOST, we assume that there exist *processes* which must communicate with processes in their own or other HOSTS. Any current definition of a process will be adequate for our purposes [13]. These processes are generally the ultimate source and destination of data in the network. Typically, within an individual network, there exists a protocol for communication between any source and destination process. Only the source and destination processes require knowledge of this convention for communication to take place. Processes in two distinct networks would ordinarily use different protocols for this purpose. The ensemble of packet switches and communication media is called the *packet switching subnet*. Fig. 1 illustrates these ideas.

Network the energy router

03 **The Independent Energy Router (IER)**

Core component the E-LAN energy network. Enable low level decentralized routing of energy to where it is needed based on active routing following command and principals from the energy protocol (EP).

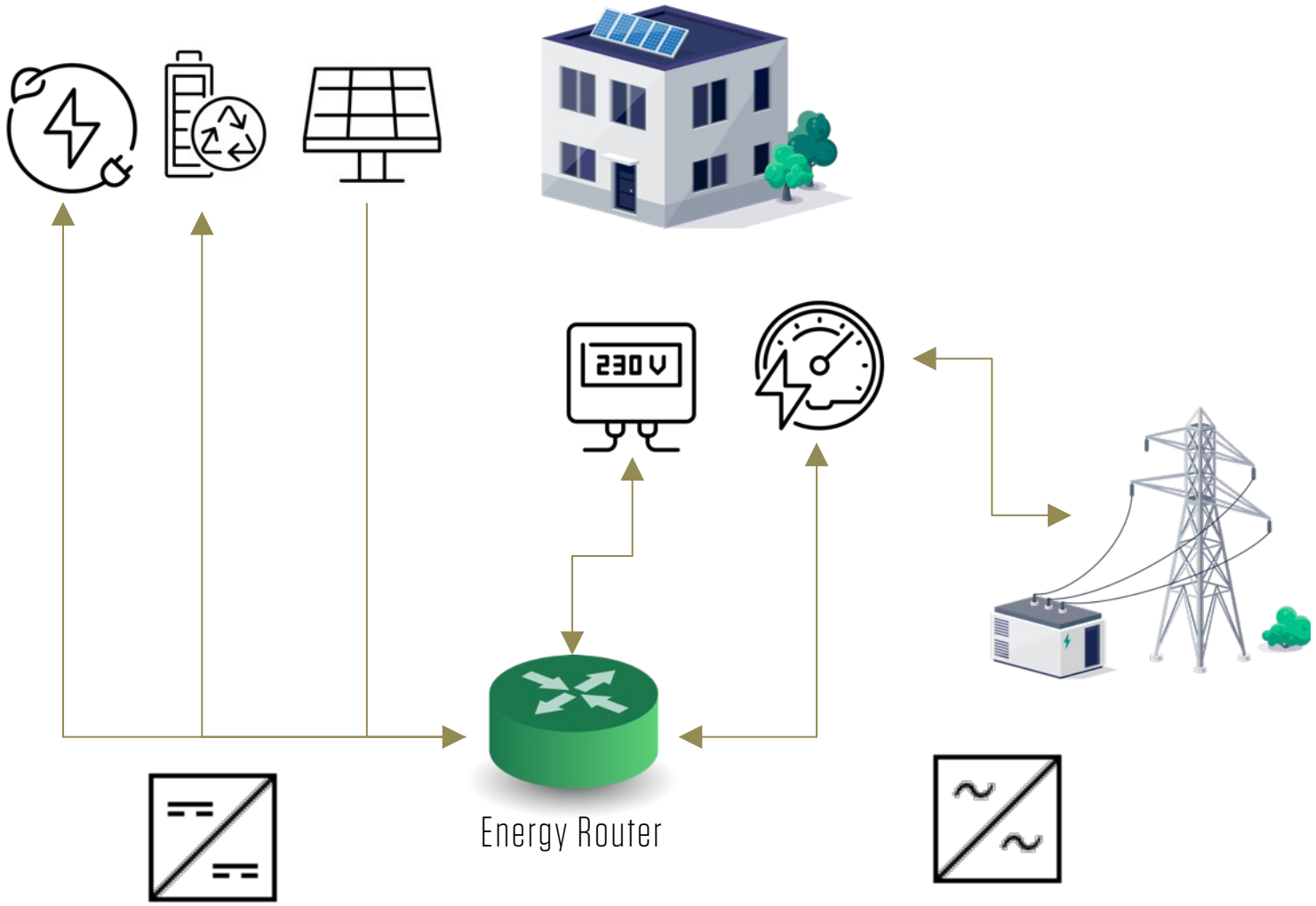
The central network element in each node

Each node, usually a building will, have at least one IER, its interfaces can be connected to the traditional grid (taking on the role of a Boarder Router), other energy communities (EC) and other nodes inside the E-LAN (typically with the organizational boundaries of an EC. Nodes can be in-building AC or DC grids but also energy storages and electrical vehicles (EV) with both charging and vehicles to X energy sharing.





EnergyNet enable independent local investments



the firewall effect

- ✓ **Unlimited local production**
- ✓ **Galvanic insolation** (DC/AC)
- ✓ **Power electronics** (EV)

The **Energy Router** plus the EnergyNet tech stack works as a "**firewall**" that with the EnergyNet operator as a Service create a local marketplace and sharing capabilities

Build locally. Build in parallel.

Repeatable local infrastructure removes unnecessary dependence on upstream reinforcement.

Upstream-dependent expansion

- Existing connection constraint
- Upstream design and approvals
- Network reinforcement
- Additional local resources commissioned

Shared upstream dependency

Parallel Short Grid deployment

Building	Block	Campus
Design locally	Design locally	Design locally
Build + connect	Build + connect	Build + connect
Operate + expand	Operate + expand	Operate + expand

Standard interfaces let many sites develop at once.

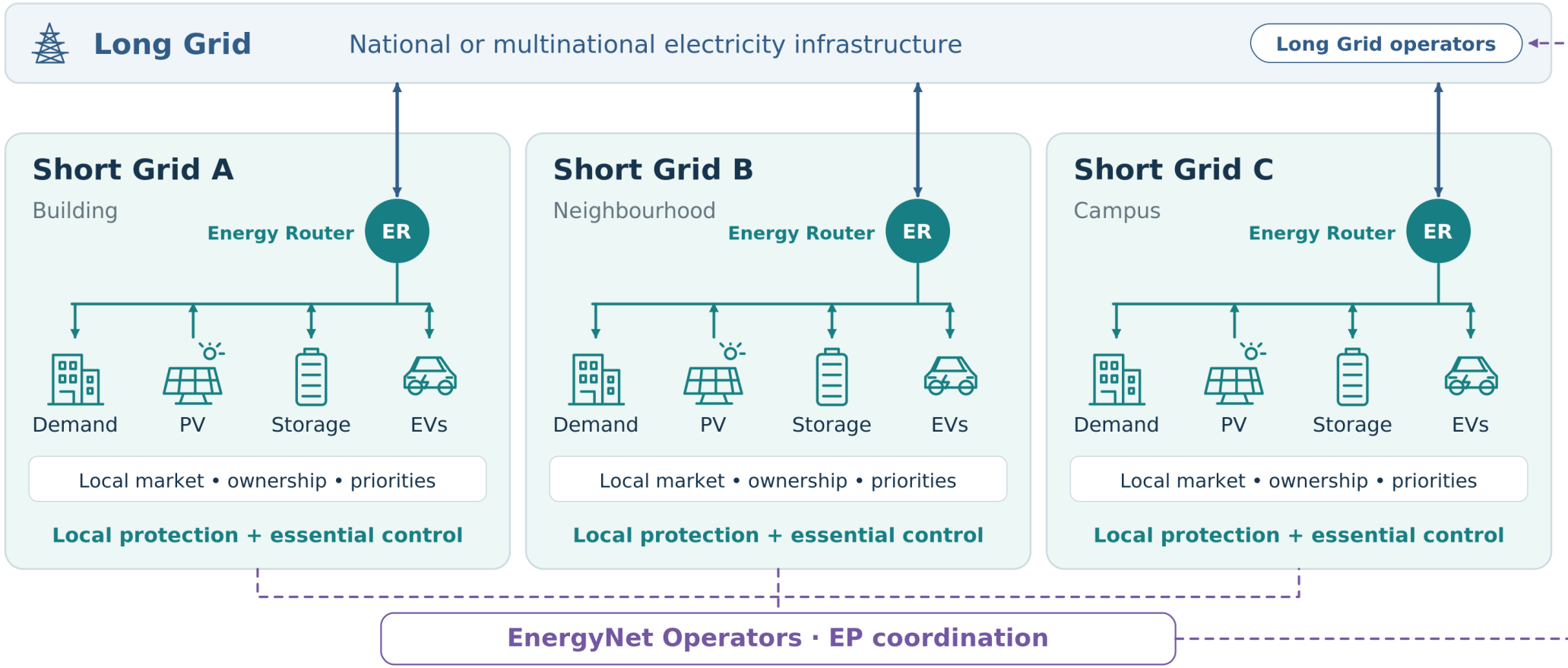
Each site still respects its approved connection envelope and local engineering requirements.

Source: Review Draft 0.4, §§1–2. Qualitative deployment sequence; no construction durations are implied.

CONCEPTUAL SCHEMATIC

Long Grid, many Short Grids

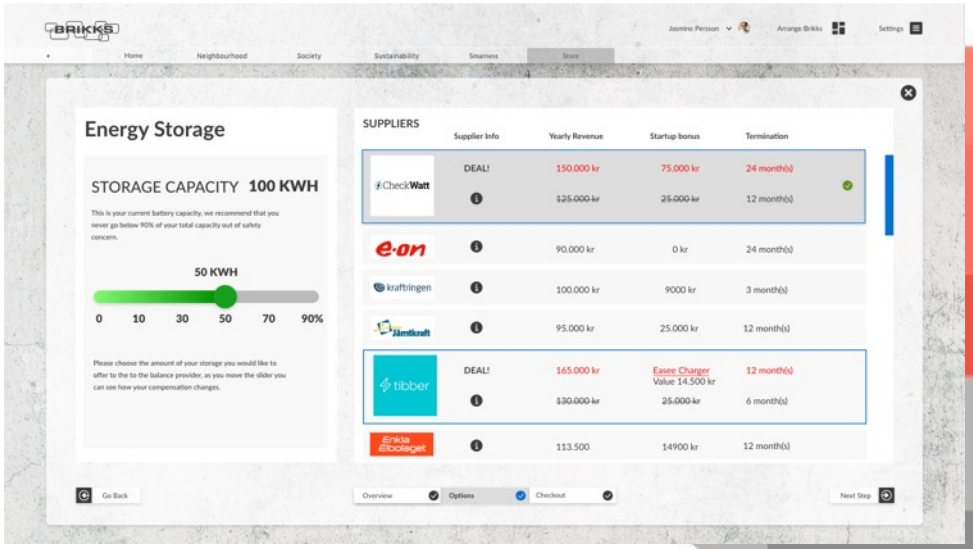
One shared infrastructure layer. Many autonomous local domains.

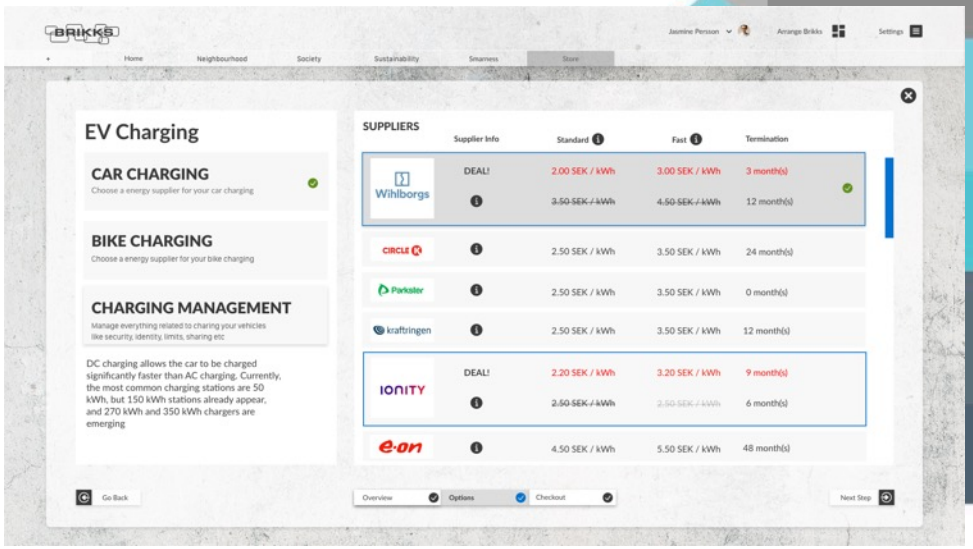


Local autonomy + network-scale coordination

Source: Review Draft 0.4, §2.3. Solid lines: electrical links. Dashed purple: coordination, not power flow.

Business model EnergyNet Operator as a Service





Services
independent service providers

ENO (ViaEuropa)
marketplace & operations

Network
energy resources

Infrastructure
energy distribution cables

Revenue share for ENO

- ✓ **Marketplaces** (sell locally)
- ✓ **Billing** (BSS/OSS)
- ✓ **Operations** (24/7/365)

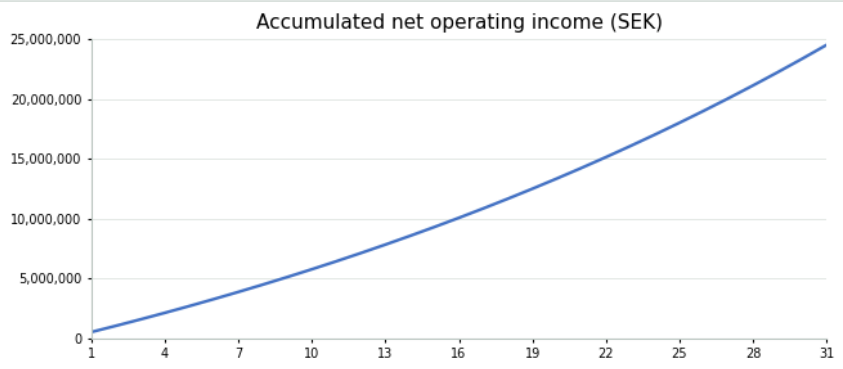
ViaEuropa is a Software driven Operator **with a revenue share on all electricity sold over the new marketplace.**

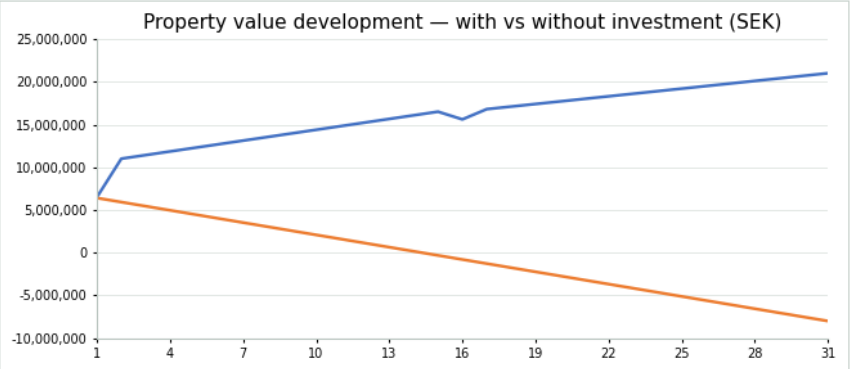
ENO also represents the Local EnergyNet vs the traditional grid operator (LSO / DSO) that create new value-added services.

EnergyNet investment case — multifamily property

Total return (ROI, 30 yrs)	Annual return (IRR)	Payback period
2.49x	6.28%	14.7 years

NOI increase, year 1 (SEK)	Net present value (NPV, SEK)	Property value increase, at exit (SEK)
+506,784	+5,613,093	+20,407,445





Energy class (EPC) — potential (PRELIMINARY)	Cost per apartment per year	Potential — NOI uplift from neighbourhood energy sharing
F → D	308 SEK	+83,596 SEK

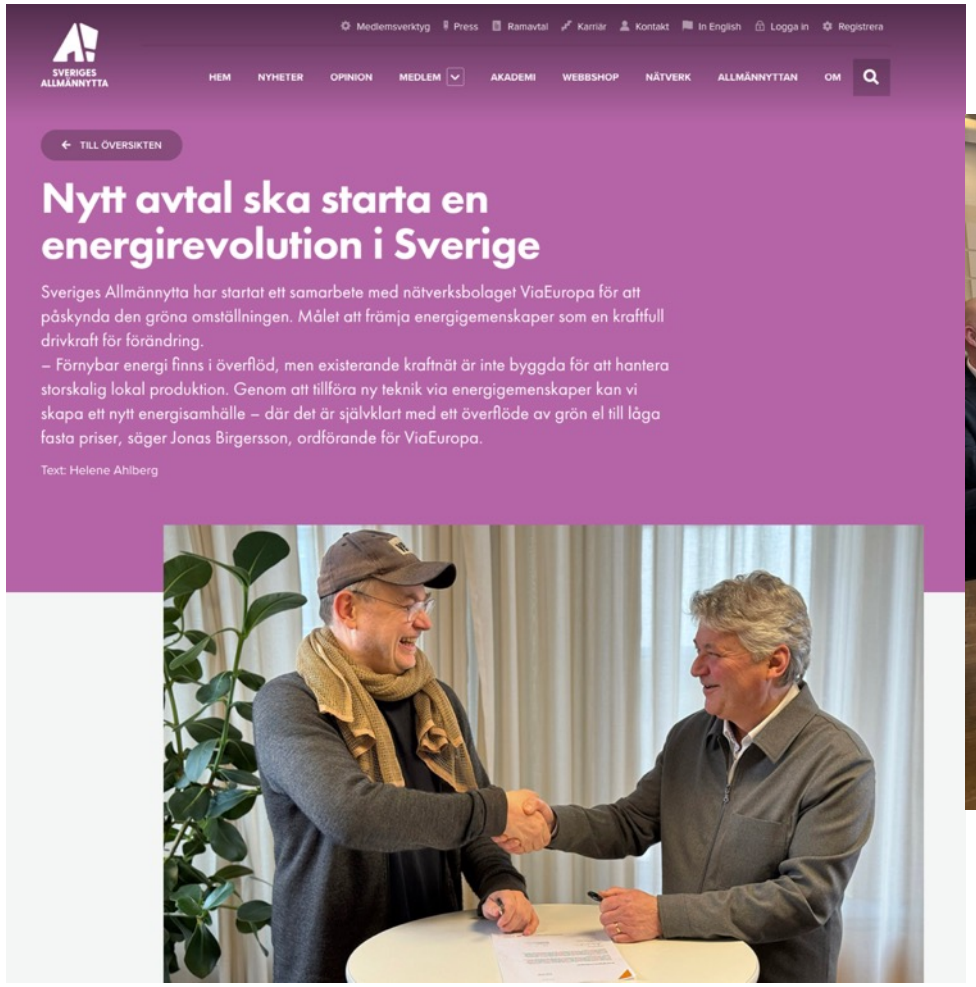
Resilience — island-mode capability	NOI contribution per apartment per year	Expense reduction per household per year
10h	9,665 SEK	−3,105 SEK

Rebalanced by 25%

Self-sufficiency	Households' annual expense reduction
5.4 months	−276,345 SEK

Rebalanced by 25%

Anonymised case output from the EnergyNet investment tool. Chart curves illustrative; headline figures per the underlying case.





Key Customers in Sweden

- ✓ **National public housing** (20% HH)
- ❑ **HSB** (7% HH)
- ❑ **Riksbyggen** (5% HH)

ViaEuropa reaches 32% of the Swedish housing market through just three contracts. VESE has active broadband contracts with all three, plus a signed EnergyNet contract with the public-housing organization (Sverige Allmännytta).

Real-estate companies and cities have strong reasons to invest in local clean energy. Infrastructure funds are now engaging too.

Read more: EU Energy Performance of Buildings Directive (EPBD)
https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en

Key Partners in Sweden

Polhem Infra AB, Swedish national infrastructure fund.
Viable Cities, a national network of 48 climate neutral cities.
Skanska AB, a Swedish global construction company.

Different systems, same answer: the built environment is #1

Comparable definition: households plus commercial, public, service or tertiary electricity. This is a physical grid-interface view, not a narrow “real-estate-company” accounting category.

SWEDEN

2024

BUILT ENVIRONMENT

75.9 TWh

60.5% of sector electricity

TOTAL SECTOR ELECTRICITY

125.3 TWh

NEXT-LARGEST USER

Manufacturing, 45.3 TWh

built environment still ranks #1

DENMARK

2023

BUILT ENVIRONMENT

19.2 TWh

63.1% of sector electricity

TOTAL SECTOR ELECTRICITY

30.4 TWh

NEXT-LARGEST USER

Agri. + industry, 10.3 TWh

built environment still ranks #1

NORWAY

2024

BUILT ENVIRONMENT

66.5 TWh

51.4% of sector electricity

TOTAL SECTOR ELECTRICITY

129.3 TWh

NEXT-LARGEST USER

Secondary industry, 60.3 TWh

built environment still ranks #1

Implication

Even in very different national systems, the largest controllable electricity interface is the building estate: homes, offices, shops, public buildings, parking, chargers, heat pumps, batteries and local generation.

Sources: SCB Sweden 2024 electricity use; Danish Energy Agency Energy Statistics 2023; SSB Norway 2024 electricity by consumer group. Denmark converted from PJ to TWh.

California vs Scandinavia: same electricity scale, different depth

The corrected comparison counts California behind-the-meter solar. The result is simple and useful: the two systems are both roughly 0.3 PWh/year, but Scandinavia gets there with far fewer people.

CALIFORNIA

ELECTRICITY FOOTPRINT

305 TWh/yr

≈49% of combined

POPULATION

39.4m

about 77% larger

ELECTRICITY / PERSON

7.7 MWh/yr

large system, lower electrification

COMBINED

TOTAL SCALE

618 TWh/yr

CA + SE + DK + NO

POPULATION

61.6m

lead-market platform

POLITICAL MESSAGE

scale + reference

one transatlantic engine

SCANDINAVIA

ELECTRICITY FOOTPRINT

313 TWh/yr

≈51% of combined

POPULATION

22.2m

about 56% of CA

ELECTRICITY / PERSON

14.1 MWh/yr

high-electrification benchmark

Takeaway: Scandinavia demonstrates the highly electrified system. California demonstrates the scale of the transition still to come.

Sources: California Energy Commission 2024 TSEG, gross consumption and BTM solar; SCB Sweden 2024; SSB Norway 2024; Danish Energy Agency 2023/2024. Rounded values; Scandinavia = Sweden, Denmark, Norway.

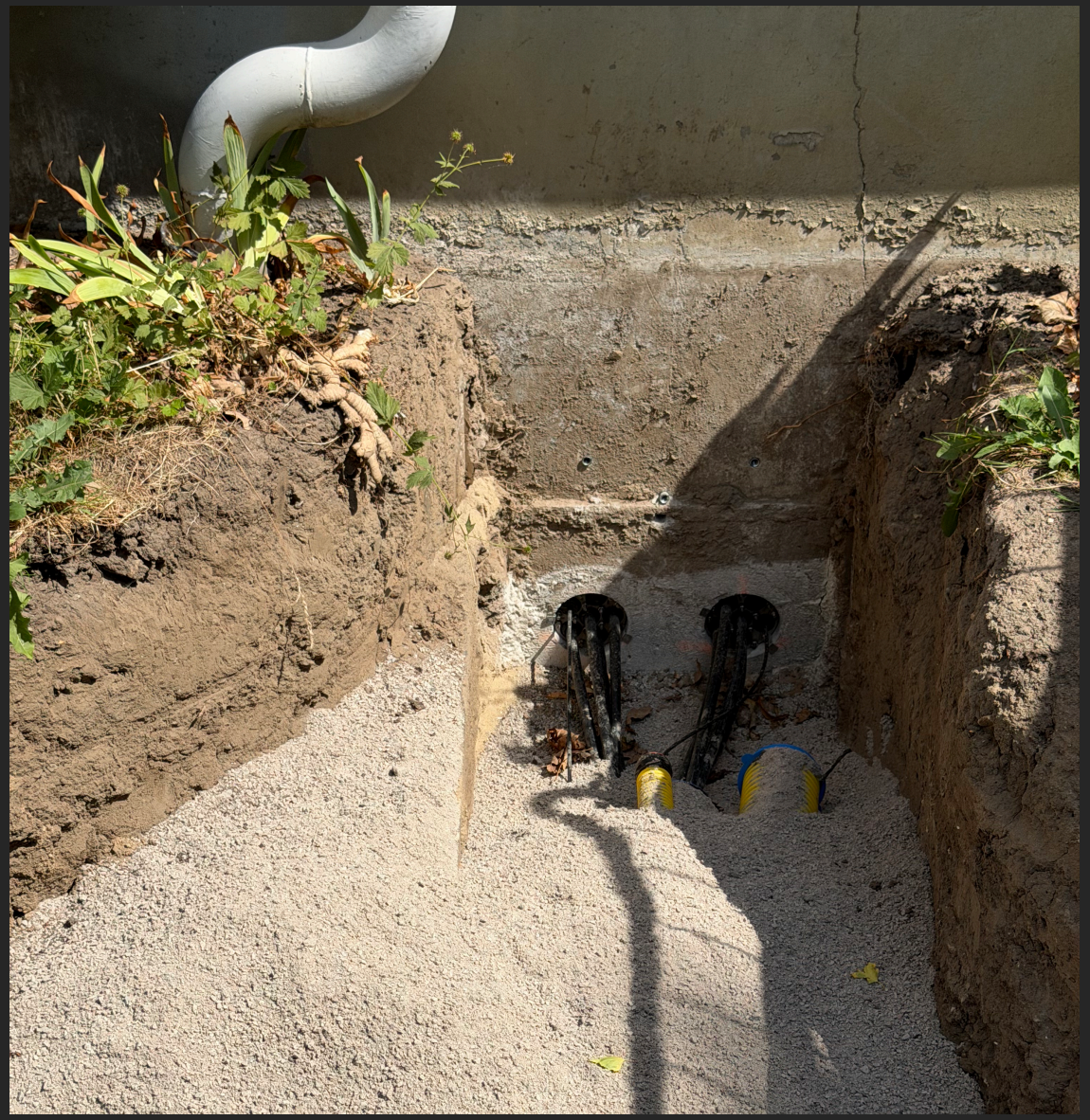
Energy cost is the key for **real estate value**

Energy cost is (together with cost of capital) the **key** recurring cost for real-estate and because of this fundamentally important for **valuation**.

With the **Energy Performance of Buildings Directive** (EPBD) energy performance of buildings will become even more important. A **building with energy class A or B will become significantly more valuable** but the opposite is also true (F or G grade) will reduce value.


A
B
C
D
E
F
G
EPBD


B e r l a y m o n t
Commission européenne




VOLVO
EC27D

Power Electronics & EnergyNet

Max Collins, PhD

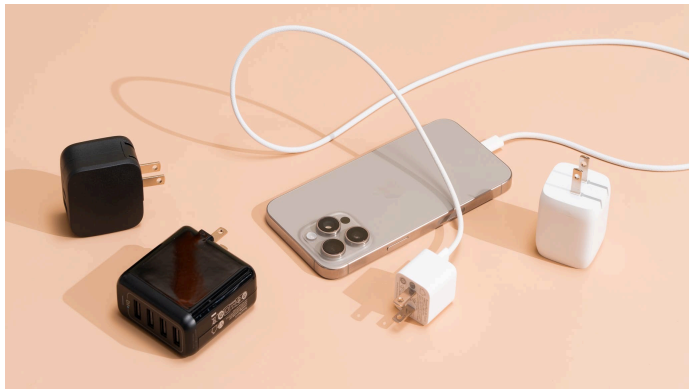
Chief Science Officer, ViaEuropa

Senior Researcher, Lund University

Power electronics what is it?

this is the hardware that converts and controls power flow between systems

= enables efficient, precise control of power and energy at scale









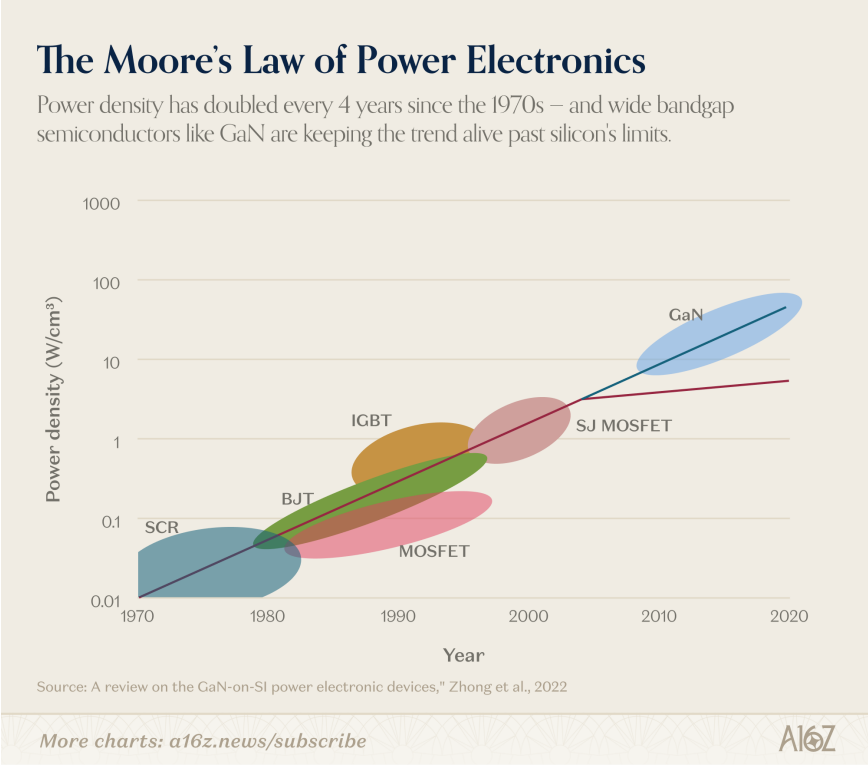


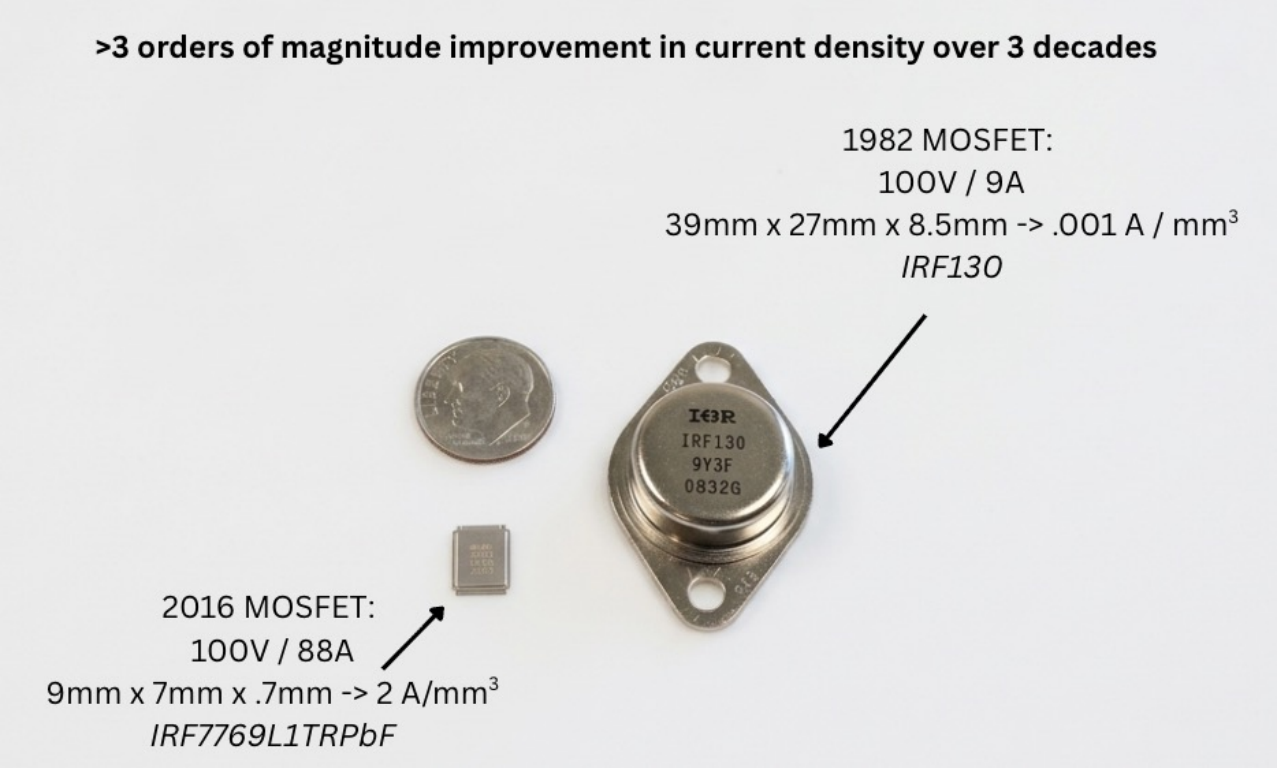


Power electronics Moore's Law

advances in semiconductor technology combined with adoption, …

= more capacity and performance per unit physical volume at lower cost





EV chargers: high-power deployed at scale

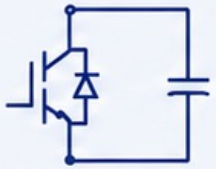
the same technology as phone chargers, at **1000x power**

- mass production: cost reduction
- standardization: improved reliability
- scale: rapid innovation cycles



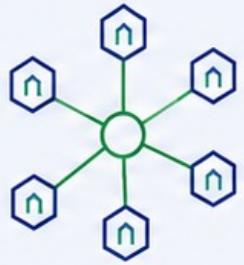
high-power electronics is now deployed by the millions in EV charging, unlocking cost, speed, and accessibility

= this is the industrial engine enabling energy routers at scale



MODERN POWER ELECTRONICS

Higher performance
Modularity
Digital controllability



ENERGYNET

Distributed architecture
Local energy sharing
Resilient by design



MORE DEGREES OF FREEDOM



DESIGN & OPERATION

How should we build the system?
How should we operate it?



SIMULATION

Explore alternatives
Quantify and compare outcomes

Quantifying EnergyNet performance: a simulation-based framework for decentralized energy networks

Max Collins, Jonas Birgersson, Marc A. Weiss, Jimmy Chen, Daniel Kammen, Marc Z. Jacobson, Newsha K. Ajami, Michael Menser, Franklin Carrero-Martínez, Jill Grey Ferguson, Henrik Ny, Tomas Kåberger

Abstract

Modern power systems are increasingly exposed to severe disturbances caused by extreme weather, infrastructure failures, and geopolitical conflicts. Conventional power systems rely on interconnected transmission and distribution infrastructure to connect generation and consumers, and failures of this infrastructure can disconnect large groups of consumers from their energy supply until service is restored. At the same time, increasing amounts of local generation, storage, and controllable loads are being deployed throughout the power system, creating new possibilities for how electrical energy systems can be organized and operated.

EnergyNet has been proposed as a decentralized, software-defined energy architecture based on interconnected power electronic Energy Routers. Each router coordinates local loads, generation, storage, and grid connections, while bidirectional Energy Links enable energy exchange between routers. Energy exchange is coordinated through the Energy Protocol, allowing routers to communicate energy needs and availability and establish energy transfer across the network. EnergyNet can operate together with the conventional grid, independently from it, or across combinations of grid-connected and isolated regions.

This paper develops a quantitative framework for modeling and simulating EnergyNet systems and calculating their performance under different operating conditions and disturbances. The framework represents network topology, prioritized loads, generation, storage, grid connections, Energy Links, and component constraints. Optimization within a time-stepped, receding-horizon simulation calculates physically feasible energy allocation and exchange. The same framework is used for deterministic disturbance analysis, long-horizon reliability screening, and probabilistic consequence analysis.

The framework is applied to an under-construction neighborhood-scale EnergyNet with ten buildings comprising 290 apartments. Full electrical service is maintained during representative summer and winter operation and following the loss of either one grid interface or one Energy Link. Simultaneous loss of two Energy Links isolates part of the network, containing the disturbance while service within the island is determined by local generation, stored energy, load priority, and repair duration. A protected-reserve sweep quantifies how stored energy affects the critical service that can be maintained throughout the disturbance. Long-horizon screening shows that network-partitioning failures are relatively rare but credible over the system lifetime, while seasonal Monte Carlo analysis shows high critical-load service across varying operating conditions, with full critical service maintained in all summer realizations and a median of approximately 92% continuously maintained in winter.

The framework provides a quantitative basis for evaluating EnergyNet operation and maintained electrical service across network configurations, resource compositions, grid conditions, and component availability.

Keywords: EnergyNet, Energy resilience, Decentralized energy systems, Microgrids, Distributed energy resources

1. Introduction

The increasing electrification of society, together with the rapid deployment of distributed generation, stationary energy storage, controllable loads, and power electronics, is changing both the structure and operation of modern power systems [1]-[4]. At the same time, extreme weather events, infrastructure failures, geopolitical conflicts, and other large-scale disturbances are placing increasing demands on the ability of electrical infrastructure to maintain essential services [5]-[6].

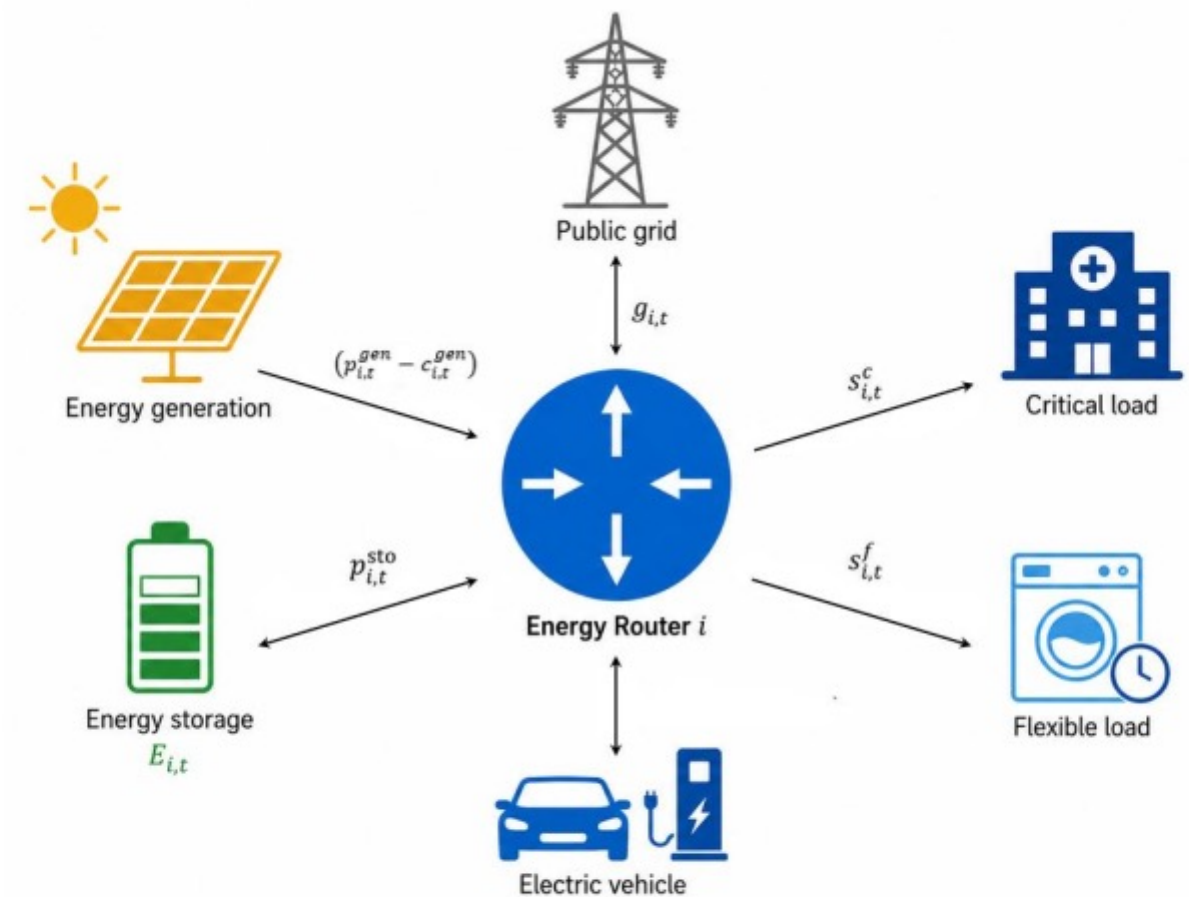


Figure 3: Operational representation of an Energy Router. Each router coordinates local energy generation, stationary energy storage, prioritized electrical loads, bidirectional electric-vehicle charging, and an optional public-grid interface.

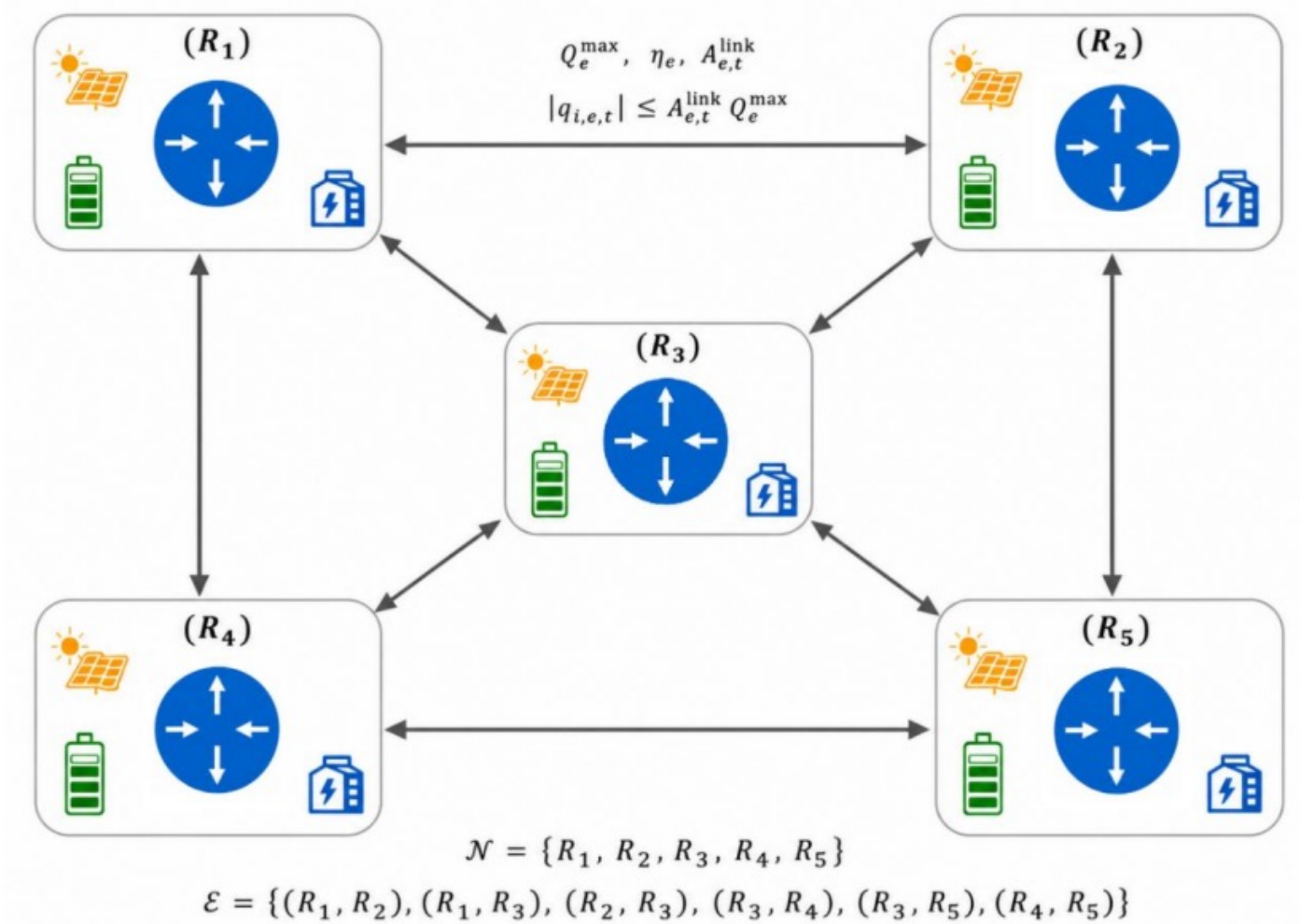


Figure 4: Graph representation of an EnergyNet. Energy Routers form the vertex set $\mathcal{N}$ and Energy Links the edge set $\mathcal{E}$. Each Energy Link e is characterized by transfer capacity $Q_e^{\max}$, efficiency η_e, and availability $A_{e,t}^{\text{link}}$, with $q_{i,e,t}$ denoting the signed power delivered to router i through the link.

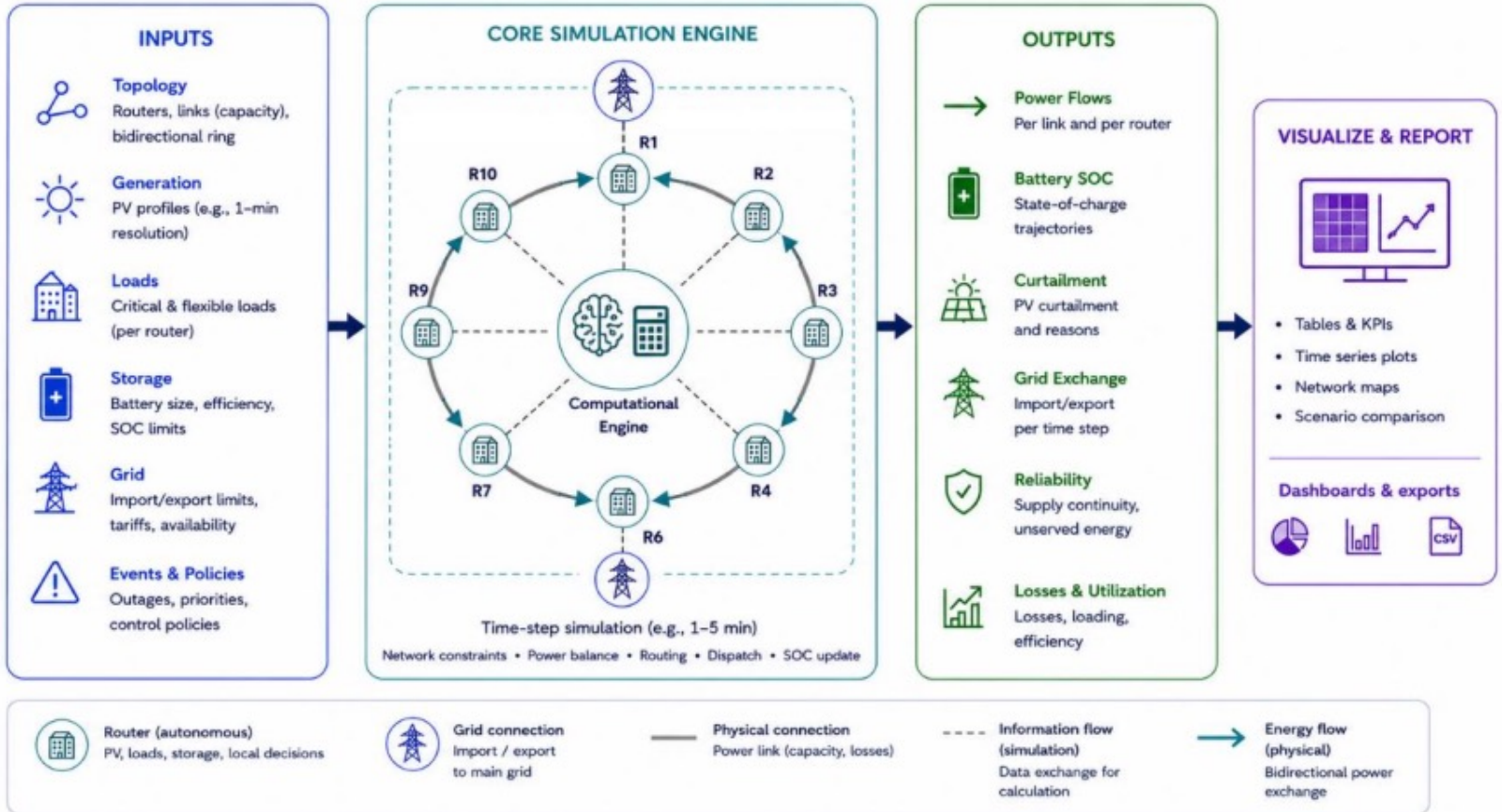


Figure 7: General simulation and evaluation framework for EnergyNet studies. The reusable EnergyNet model and optimization-based dispatch framework are combined with a study-specific system instance, operating conditions, and operational assumptions. Time-stepped simulation produces a complete operational record from which application-specific performance metrics are evaluated. Deterministic, parametric, and Monte Carlo studies modify or sample the study definition while preserving the same underlying model and simulation procedure.

Example EnergyNet in Sweden, customer LKF



10 buildings, 278 homes, use 8000 000 KWh/y
wanted to build solar, got **no** from traditional grid owner.

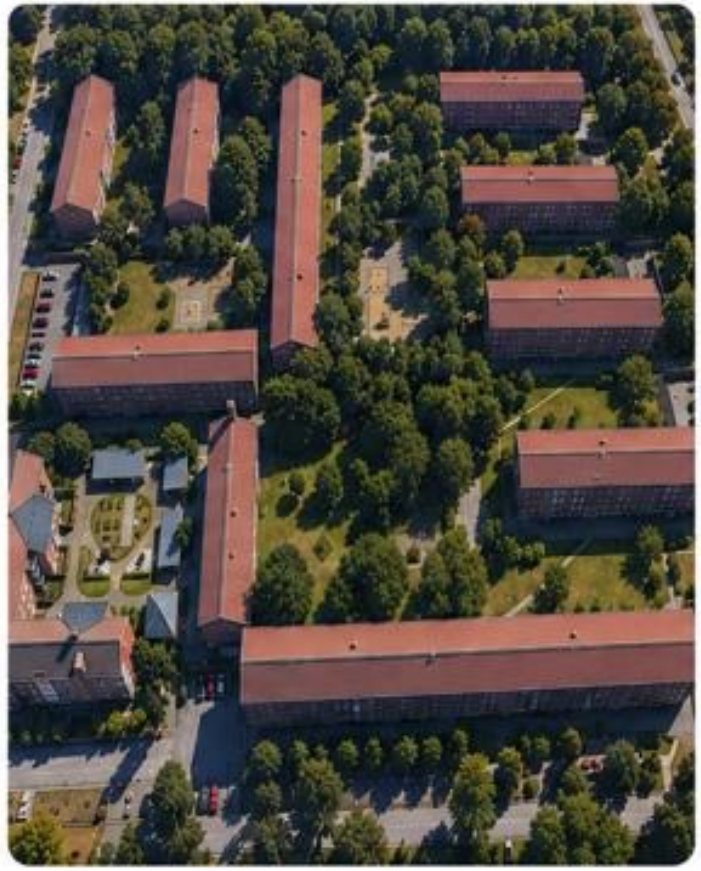
Unblocked clean energy

- ✓ **Solar, battery & EnergyNet** (Routers & local grid) reduce grid power with 60% annual
- ✓ **For 6 month no old grid is needed**
- ✓ **Add wind, old grid is only needed 14 days/year**
- ✓ **Add H2 fuel-cell and no old grid is needed**

Investment is made by the real estate company and is profitable. ViaEuropa develops the project and is the long term EnergyNet operator.

1. Real-World Geography

Actual district (aerial photo)



- Real buildings, trees, roads
- Exact location and surroundings

2. Model Representation

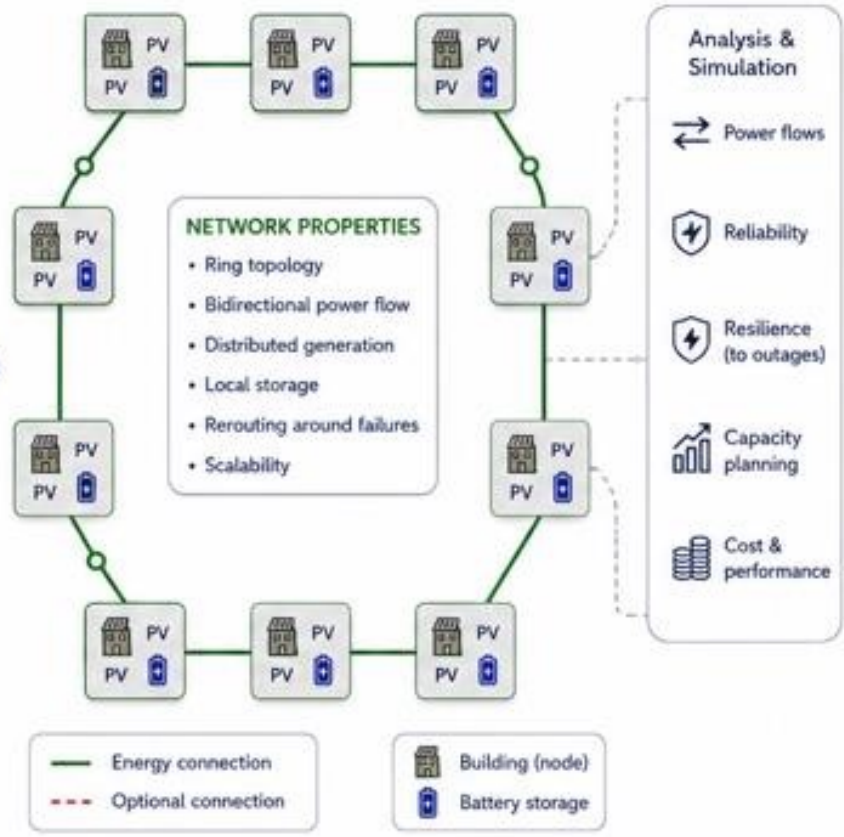
Toy model of the district (for simulation)



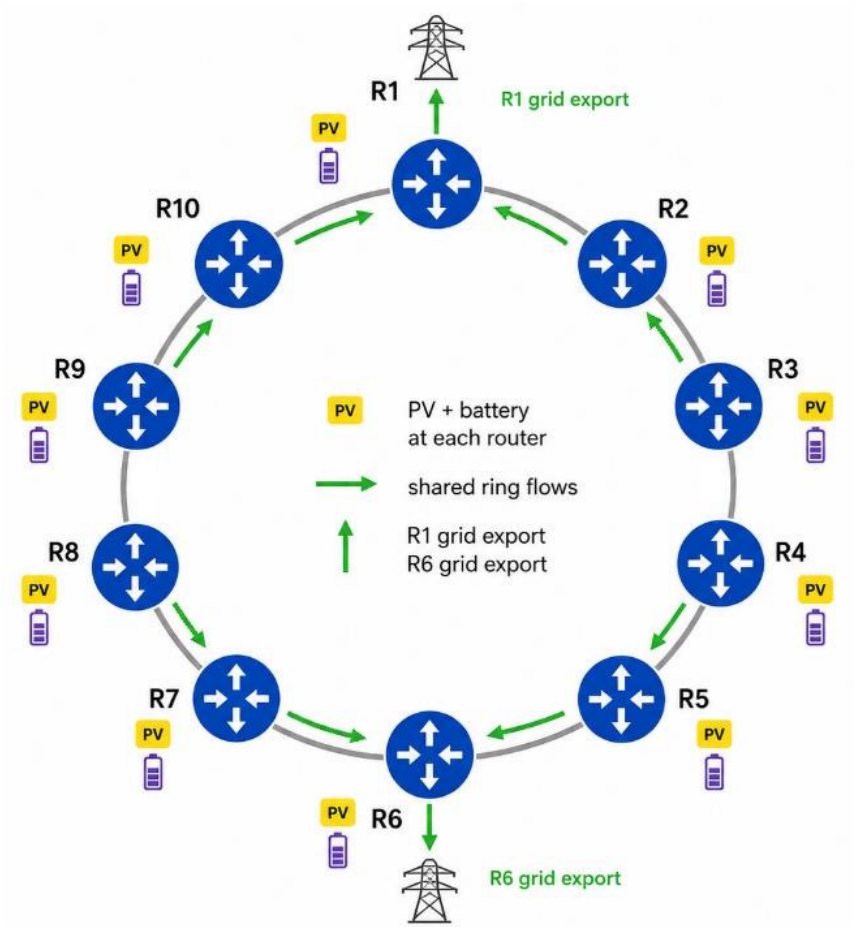
- Buildings with PV, batteries, and loads
- Paths and connections represented
- Input for simulations
- Physical constraints preserved

3. EnergyNet Abstraction

Mathematical abstraction (resilient ring network)



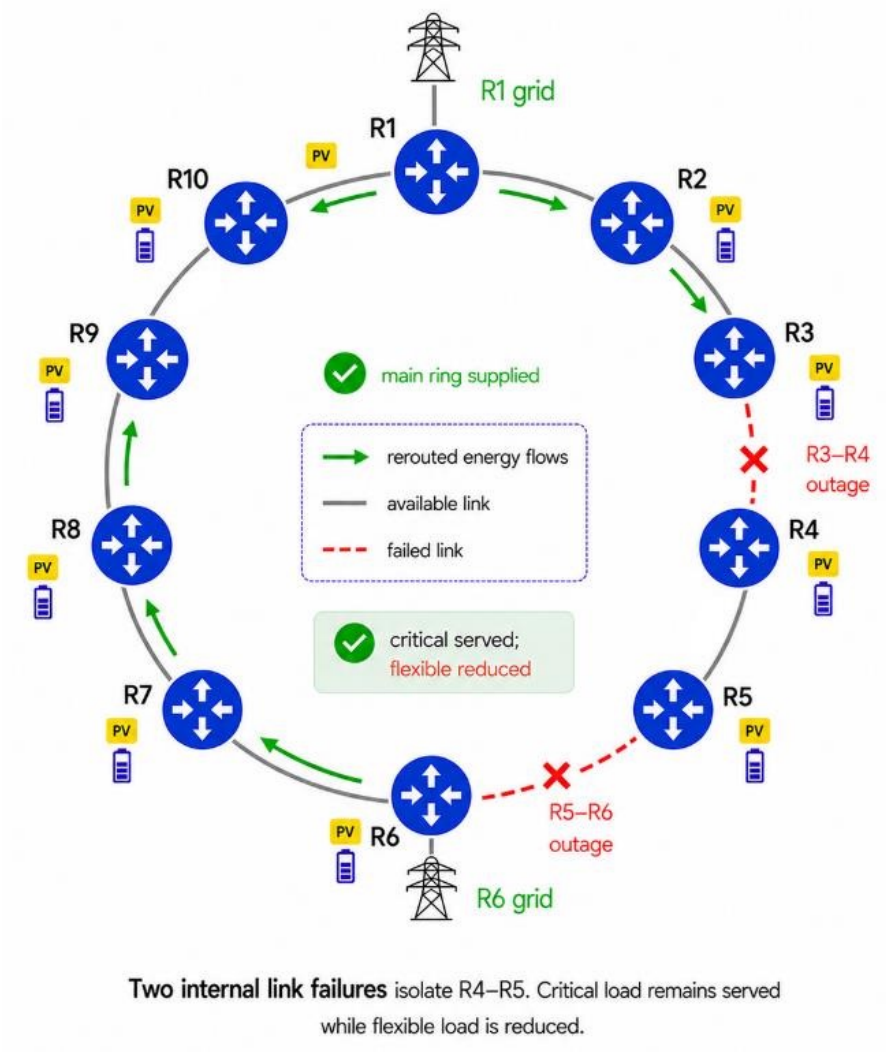
- Buildings become nodes in a ring
- Connections form the EnergyNet topology
- Mathematical model for analysis & optimization
- Used to test scenarios and design for resilience



Summer operation: local PV and batteries serve the apartment ring; surplus energy is exported through the grid interfaces.

Summer high-solar operating period





Two internal link failures isolate R4–R5. Critical load remains served while flexible load is reduced.

C3: stable emergency service with 10% protected reserve



EnergyNet Simulation use cases



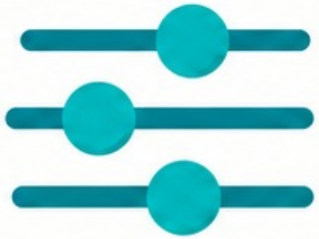
SYSTEM DESIGN

Size routers, solar, batteries and connections



RESILIENCE PLANNING

Test outages, failures and emergency operation



OPERATIONAL STRATEGY

Decide when to store, share, import or prioritize energy



INVESTMENT PLANNING

Compare configurations before committing capital



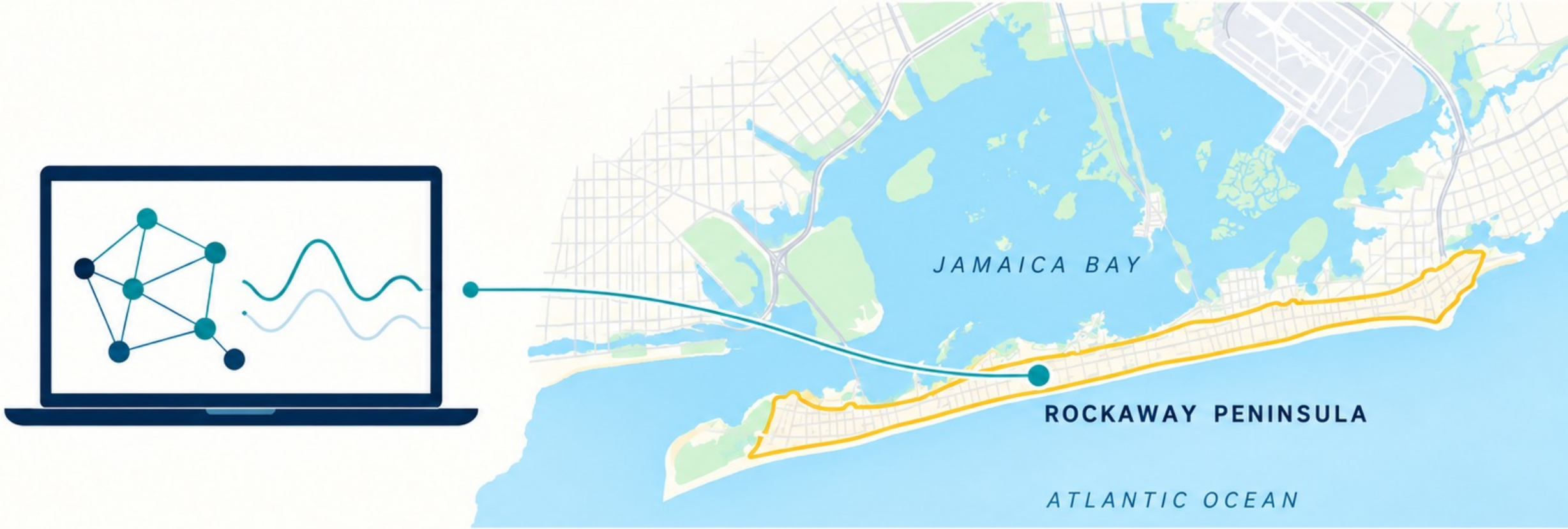
POLICY AND REGULATION

Test tariffs, connection rules and energy-sharing models



EXPANSION PLANNING

Identify where the next site or connection adds the most value



Applying the EnergyNet simulation framework to a real resilience challenge

New York Hurricane Sandy, 2012







GRID OUTAGE Heating Lighting Communications Refrigeration Medical Power

Safe and Affordable Energy for Rockaways

SAER Preliminary Draft Strategy

Project Goal/Summary

Secure and Affordable Energy for Rockaways (SAER) is a plan to dramatically improve energy security and community resilience across the Rockaway Peninsula, one of New York City's most climate-vulnerable regions. This will be achieved through the installation of a new energy distribution system, called the EnergyNet. The EnergyNet establishes a new architecture of decentralized, adaptable, and fault-tolerant energy distribution that will alleviate many present resilience issues in the Rockaways. By installing the EnergyNet across the region, the SAER project reduces dependence on the fragile, centralized grid, enhances disaster response capability, and brings the energy infrastructure into the modern age. With the long term vision of installing the EnergyNet across the entire Rockaway Peninsula, the SAER project begins with the Phase 1 area outlined in this document, located between Arverne and Edgemere, from Beach 28th Street to Beach 60th Street.

The Rockaway Peninsula is highly vulnerable to environmental damage, suffering repeated infrastructure damage in the past during major storms, flooding events, and coastal surges. In particular, the power distribution system, which enables critical functions for everyone through heating, lighting, etc. has repeatedly failed in the face of major storms. The traditional grid (Plain Old Grid System; POGS) is not designed to withstand storm-scale physical damage, or to operate around faults. During events like Hurricane Sandy, outages lasted weeks, withholding essential services such as: heating, lighting, communications, refrigeration, and power for medical devices and community shelters.

POGS improvement efforts have been insufficient because they continue to rely on the centralized, unstable system with inherent single points of failure. While New York City has made progress in deploying site-specific microgrids, these efforts are fragmentary, creating "energy islands" that help individual facilities, but do not provide coordinated resilience across a community or region.

EnergyNet systems installed in the SAER Phase 1 region will improve energy security by introducing a new architecture, on top of the POGS, that contains two foundational shifts in design:

1) Software-controlled (smart) microgrids that are electrically isolated and self-monitor;
2) A completely bidirectional network of energy distribution between microgrids.

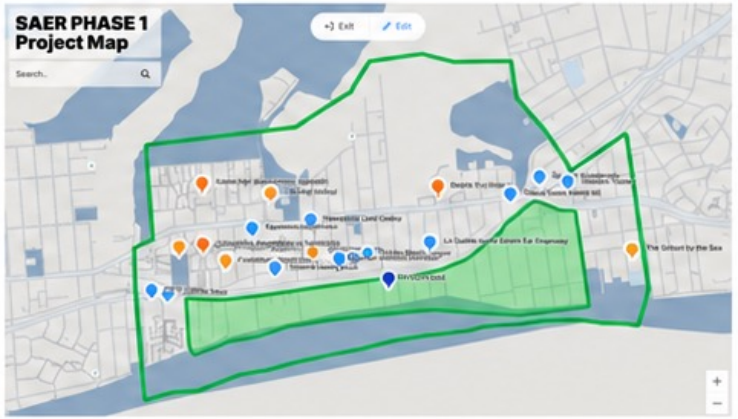
While microgrids alone have already proven valuable for community resilience in New York City and beyond, the combination of advanced microgrids plus a unifying, intelligent routing and communications layer results in a system with no single point of failure. Each element of the system, be it a microgrid or a distribution line, is individually isolated and can be routed around in the event of damage. There are many routes through the network, and with each microgrid producing and storing its own energy, there is always power to flow in the system even when some elements are damaged. The EnergyNet shifts the outlook of resilience and disaster management from creating isolated cases of power within region-wide power outages to isolated cases of power outage in a region-wide, powered network.

In a disaster, some power is better than none, and the EnergyNet ensures that communities retain access to critical energy even when the POGS is compromised. Power can be redirected around outages, distributed to where it is needed most, and supplemented from neighboring nodes in the network.

The installation of an EnergyNet system as outlined in this proposal is expected to have the following impacts:

- More reliable energy supply during storms, outages, or grid disruptions.
- Enhanced support for critical services, including schools, fire departments, food distribution hubs, and residential buildings.
- A flexible platform for future clean-energy adoption, including EV charging, community solar, and storage coordination.

SAER Phase 1



The SAER Phase 1 area extends from Beach 28th Street to Beach 60th Street in the Rockaway Peninsula. It involves the following 20 projects between Arverne and Edgemere:

1. Arverne East
2. Edgemere Commons
3. Covered Parking Lot at 50-01 Rockaway Beach Blvd.
4. Rockaway Care Center
5. Arverne View
6. La Quinta Inn & Suites Far Rockaway
7. Seaview Home for Adults
8. Seaview Towers
9. Seagirt Residences
10. Beach Green Dunes I
11. Beach Green Dunes II
12. Beach Green Dunes III
13. NYCHA Beach 41st Street
14. NYCHA Ocean Bay Apartments (Bayside)
15. NYCHA Ocean Bay Apartments (Oceanside)
16. The School by the Sea – P.S./M.S. 43Q
17. FDNY EMS Station 47
18. Arverne Branch Library
19. Cardozo School and Playground
20. P.S. 105 The Bay School

These projects together contain over 8,000 housing units, plus critical non-residential facilities, like schools and a fire department. They are selected to incorporate the denest cluster of critical facilities, large residential developments, and projects with existing local generation and storage assets to efficiently make a significant impact. The benefit of this clustering for Phase 1 is that, by covering a smaller area, less new cable installation is required to connect the systems, improving efficiency and lowering potential costs. The SAER Phase 1 area, beyond just the 20 chosen buildings, covers a population of 20,000, who will all benefit from the strengthened infrastructure and improved disaster response enabled by an EnergyNet system.

Issues with the Existing Grid

The POGS is fundamentally the same energy distribution system that it was when created in the late 1800s, with two major issues. It is a centralized system that routes power in one direction: from a few large power plants, to consumers; the loss of one of these power plants, or any damage to the wires delivering power, causes huge impacts to the system. It also relies on analog controls and real-time balancing, resulting in an unstable system that must be carefully balanced and finely tuned or else the system shuts down, like in the 2025 Iberian Peninsula blackout.

What is the EnergyNet?

The EnergyNet is an **energy distribution system** using a **network of smart microgrids** created in Sweden. The size of these microgrids can vary, but typically cover an individual building or home. Each microgrid is capable of independent operation, and all other standard benefits of traditional microgrids, but it also interfaces with the network, enabling coordinated

How EnergyNet enables SAER



HIGH-PLACEMENT INSTALLATIONS

Equipment remains above expected flood levels.



ACTIVE SAFETY MONITORING

Continuous monitoring helps prevent short-circuit house fires.



MODULAR FLOOR WIRING

Unaffected floors can remain powered.



RAPID EMERGENCY CONNECTIVITY

Modular ports let generators and replacement links plug in quickly.



NETWORK-LEVEL REROUTING

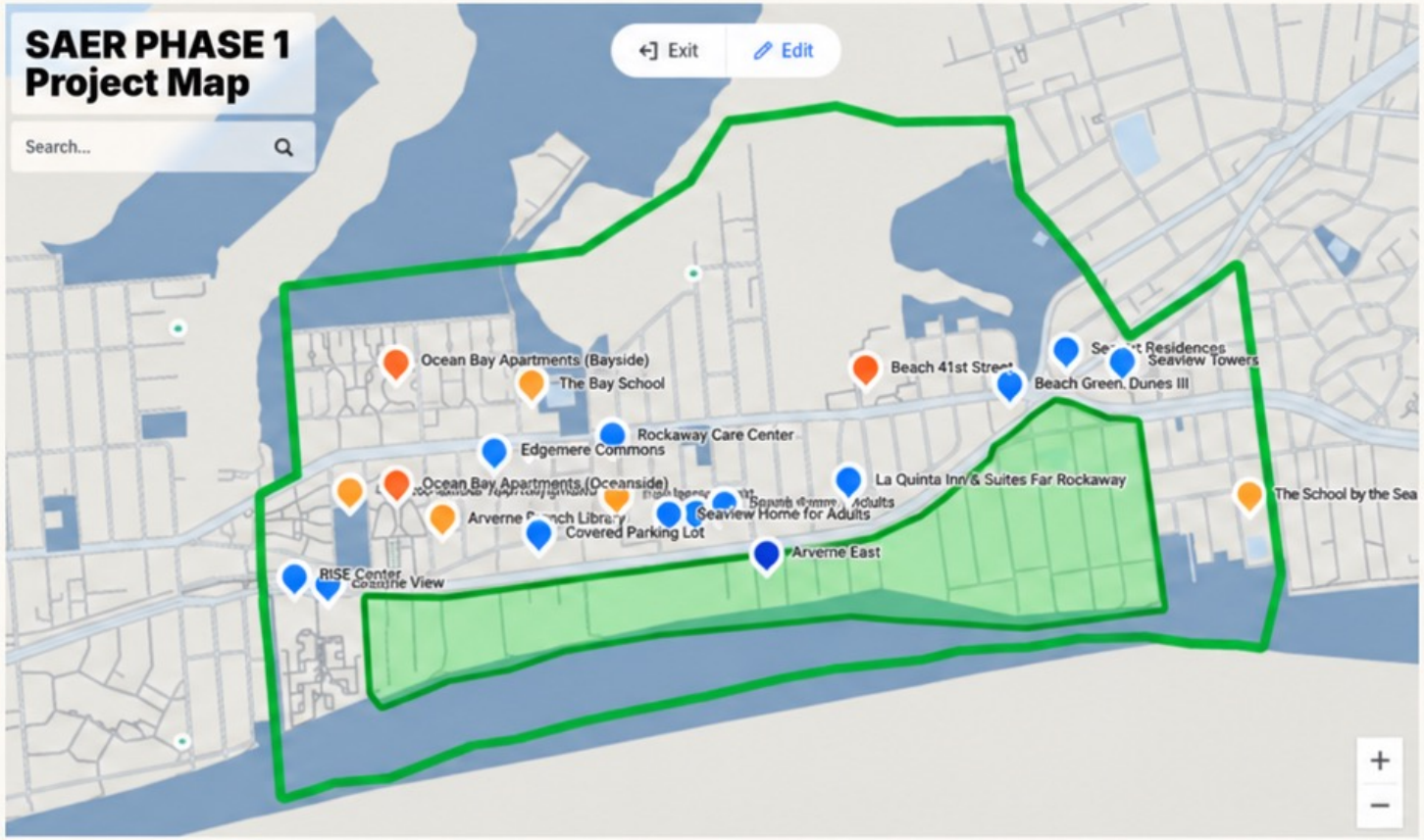
Power automatically bypasses damaged elements.



CRITICAL-LOAD PRIORITIZATION

Choose which loads to prioritize—such as hospitals and fire departments.

SAER Phase 1 Project Map

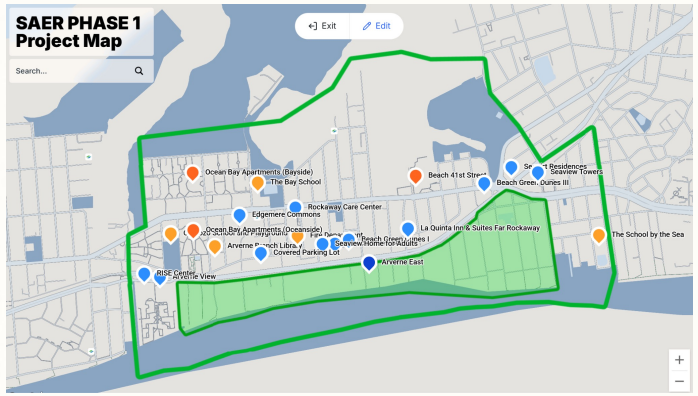


1. Arverne East
2. Edgemere Commons
3. Parking Lot Rockaway Beach Blvd.
4. Rockaway Care Center
5. Arverne View
6. La Quinta Inn & Suites
7. Seaview Home for Adults
8. Seaview Towers
9. Seagirt Residences
10. Beach Green Dunes I
11. Beach Green Dunes II
12. Beach Green Dunes III
13. NYCHA Beach 41st Street
14. NYCHA Ocean Bay Apartments (Bayside)
15. NYCHA Ocean Bay Apartments (Oceanside)
16. The School by the Sea P.S./M.S. 43Q
17. FDNY EMS Station 47
18. Arverne Branch Library
19. Cardozo School and Playground
20. P.S. 105 The Bay School

20
sites / short grids

8000+
housing units

20,000+
people







SAER PORTFOLIO

ENERGYNET MODELS

QUANTIFIED OUTCOMES

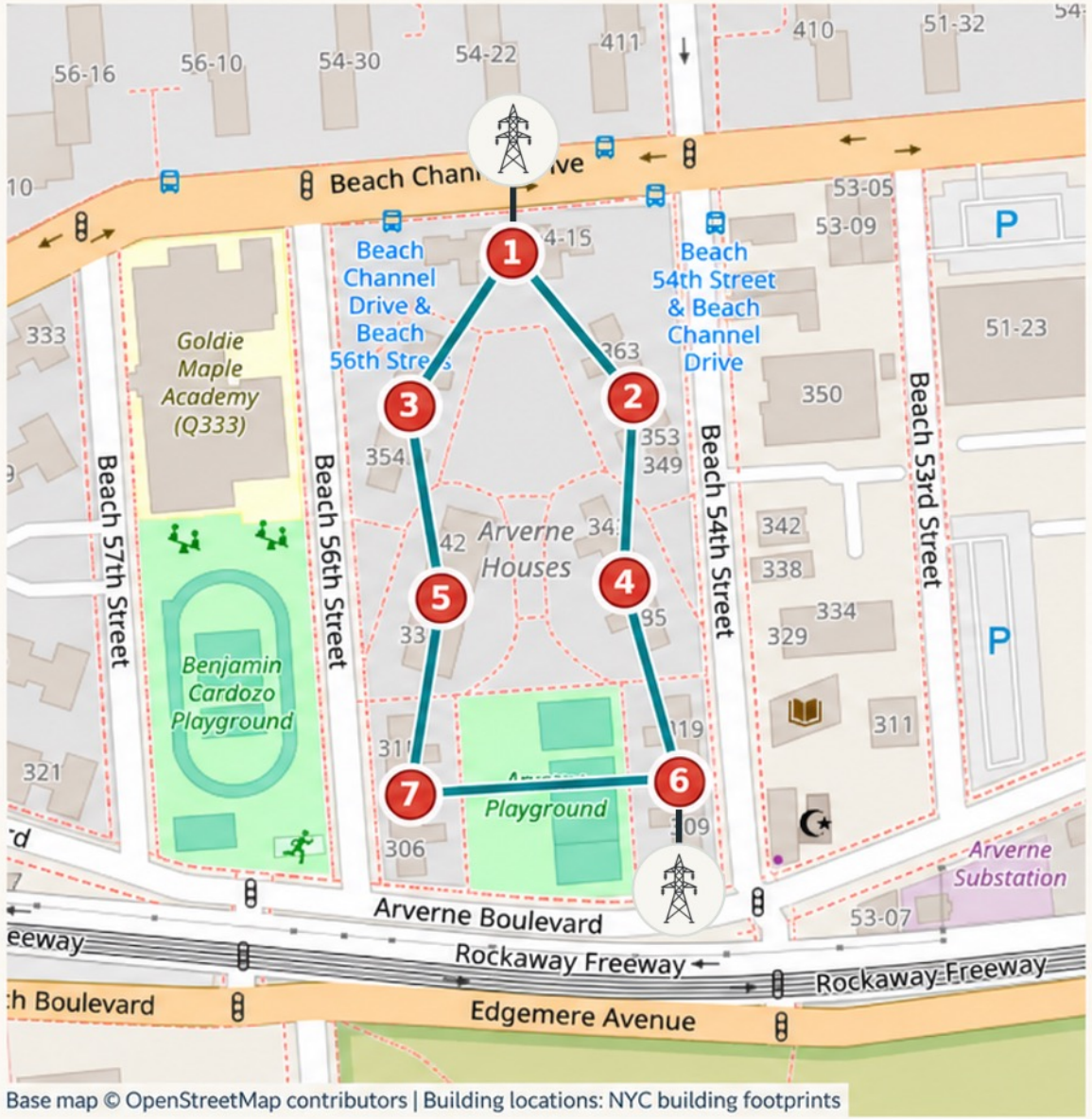
Study NYCHA Ocean Bay Apartments (Oceanside)

seven apartment buildings comprising 418 homes – one EnergyNet ring

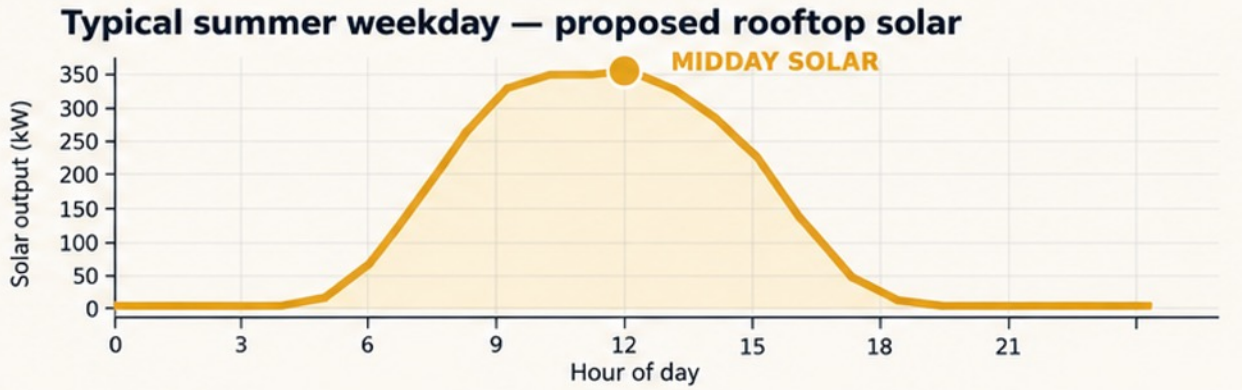


Seven buildings become one EnergyNet

Each building can generate, store and consume energy independently – and exchange with neighbors







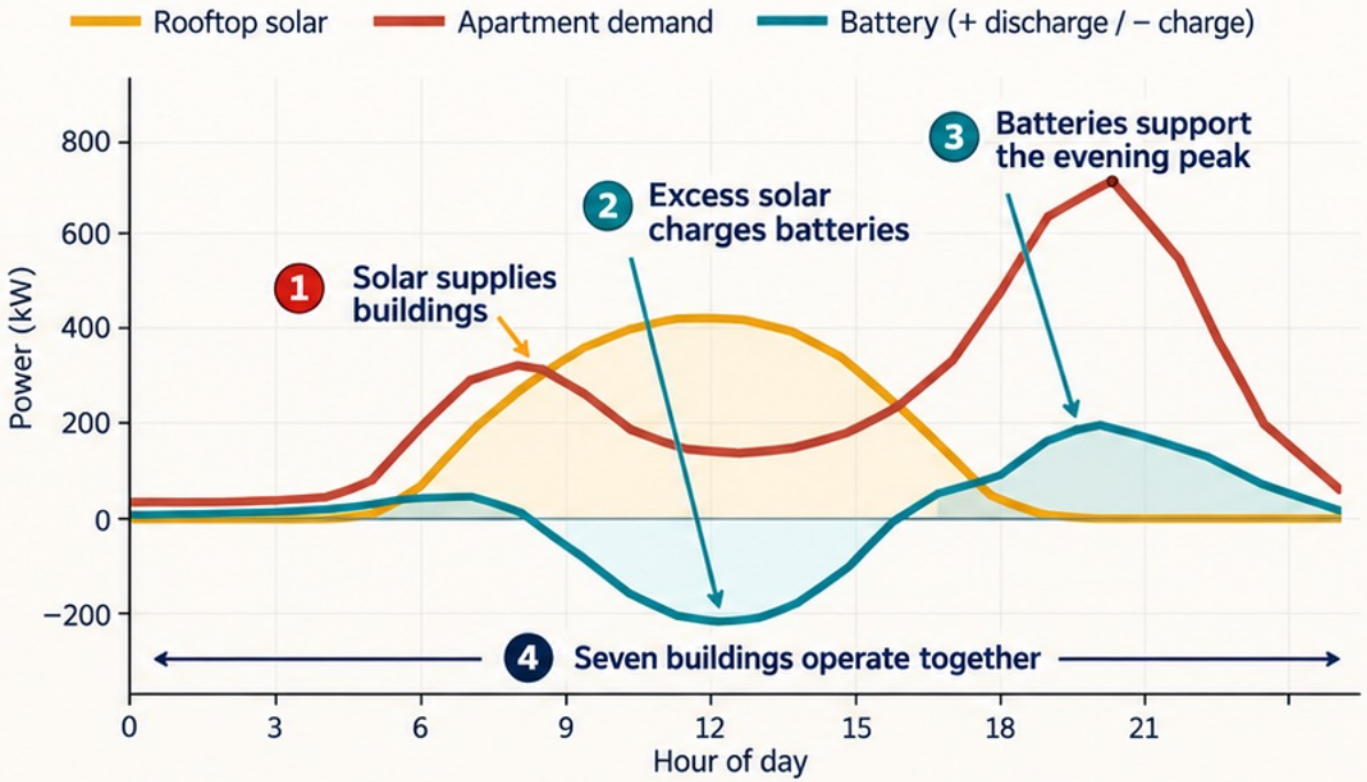
7	buildings
418	homes
500 kWp	rooftop solar
500 kW / 2 MWh	battery
7	energy routers

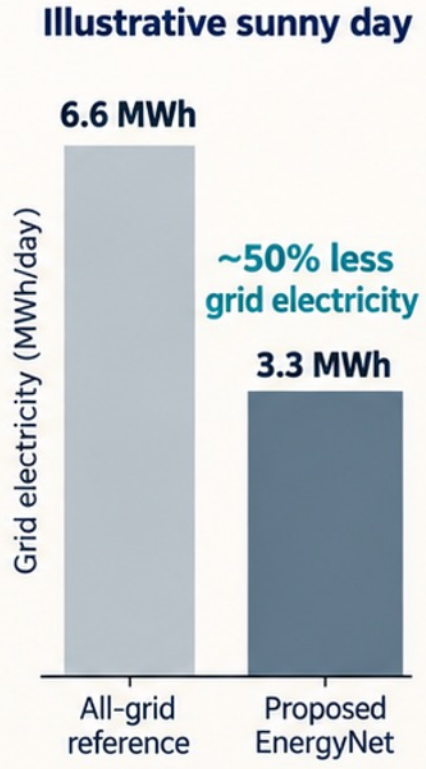
The ring keeps each building connected even if a link fails.

NYCHA Ocean Bay Apartments (Oceanside) – normal operation



Seven buildings. Seven energy routers. One coordinated ring.





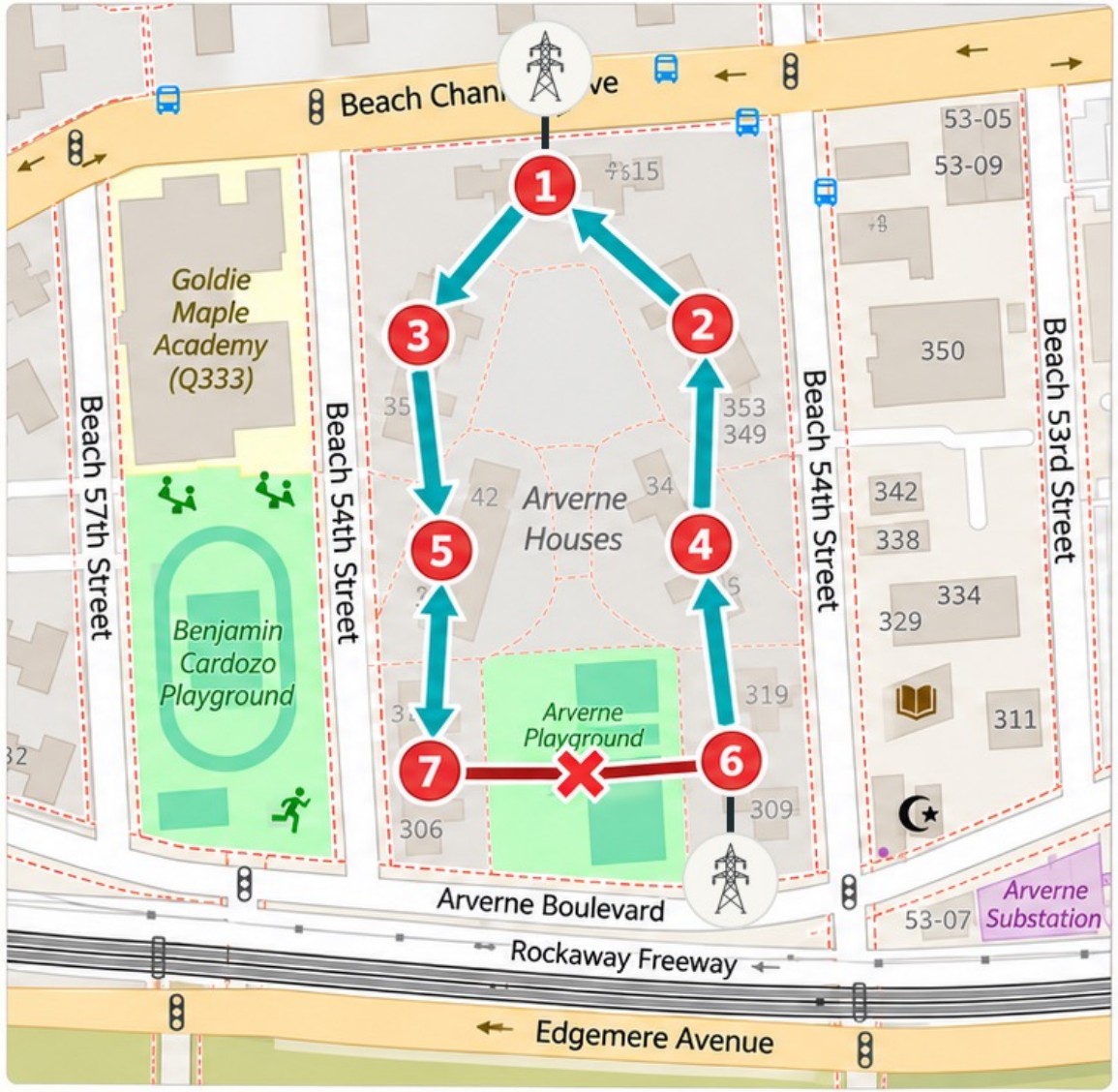
3.3 MWh
solar generated

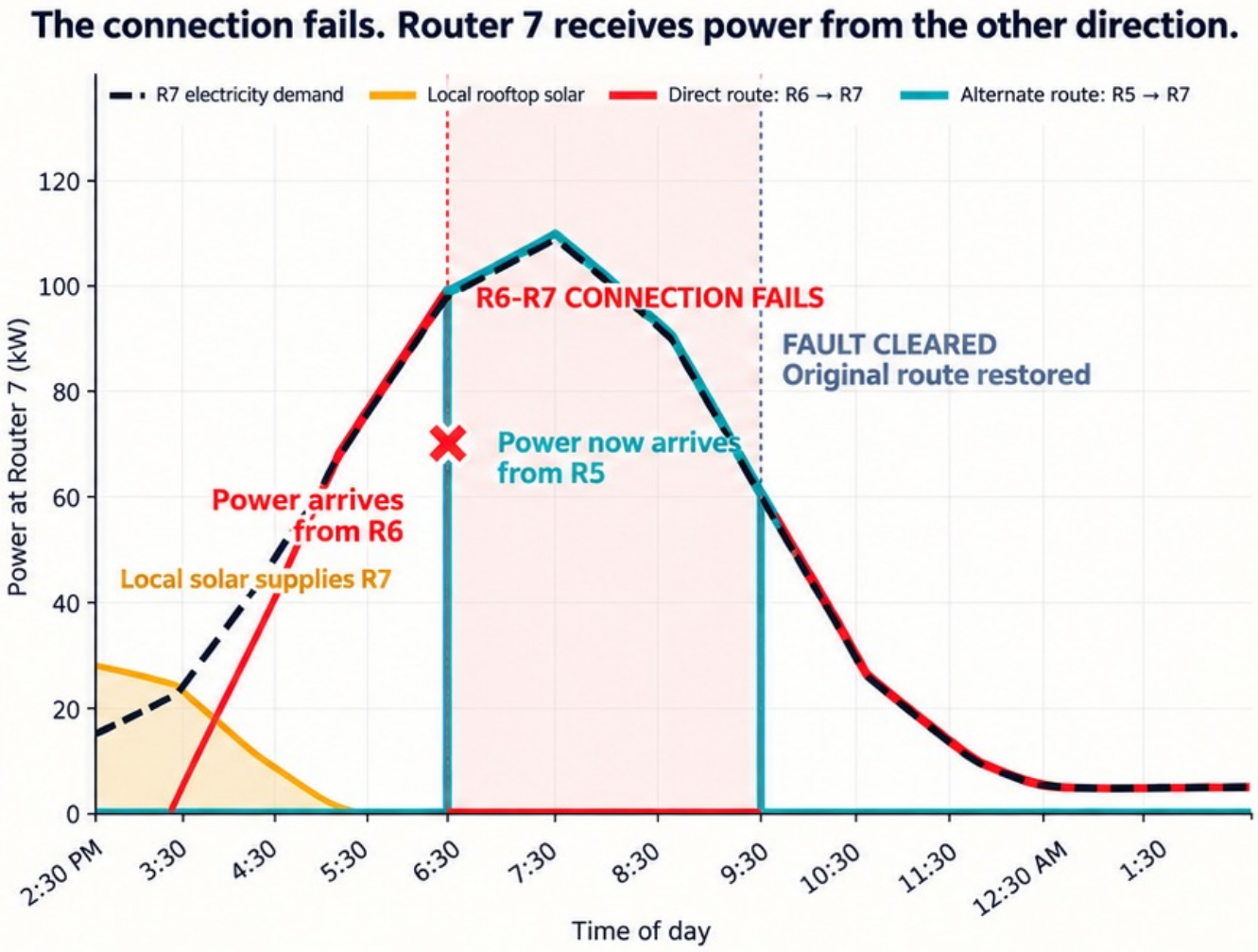
1.2 MWh
shifted through batteries

~50%
less grid electricity

Solar generated in the middle of the day is stored and used when residents need it in the evening.

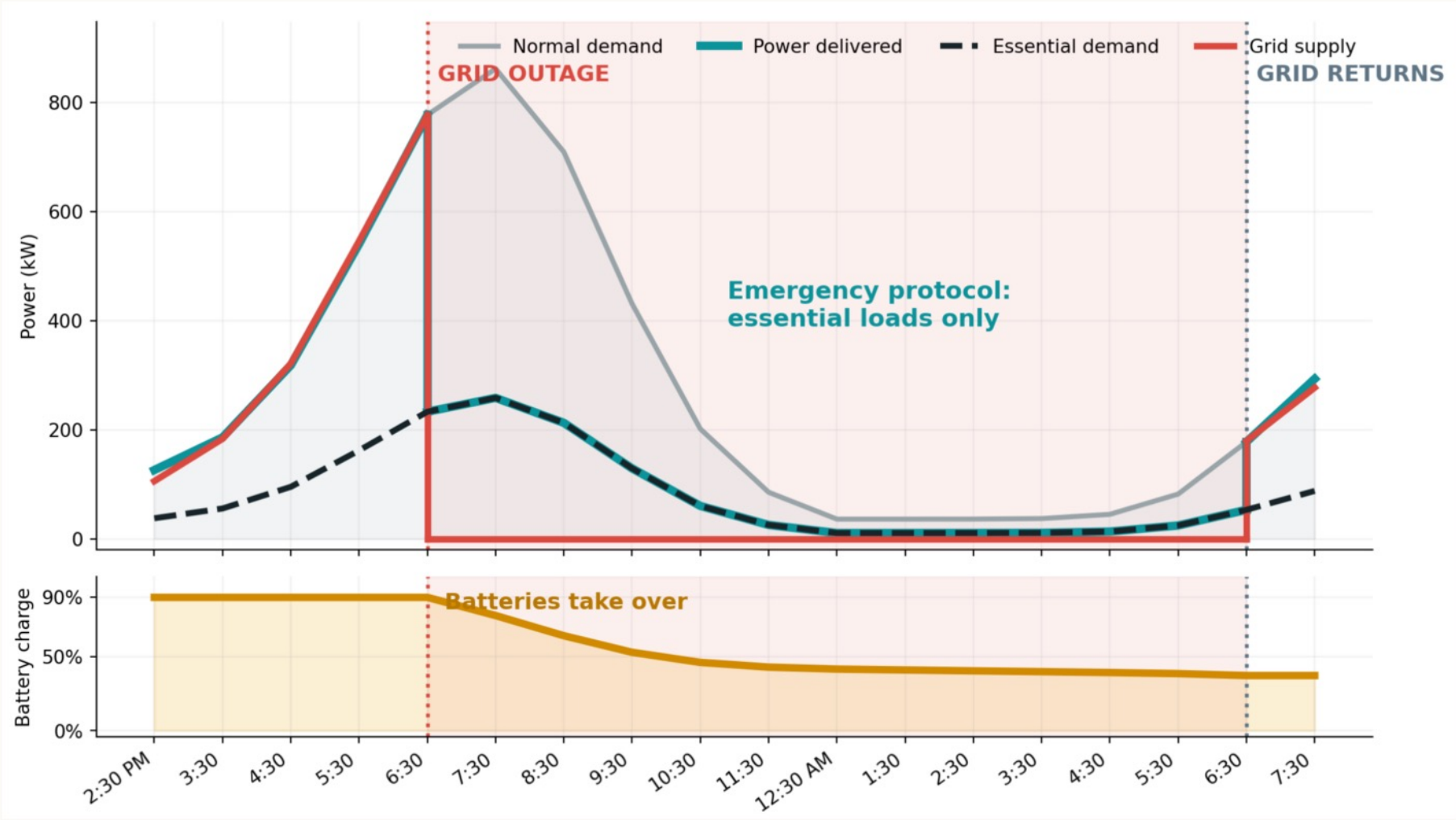
NYCHA Ocean Bay Apartments (Oceanside) – router link outage





NYCHA Ocean Bay Apartments (Oceanside) – complete grid outage



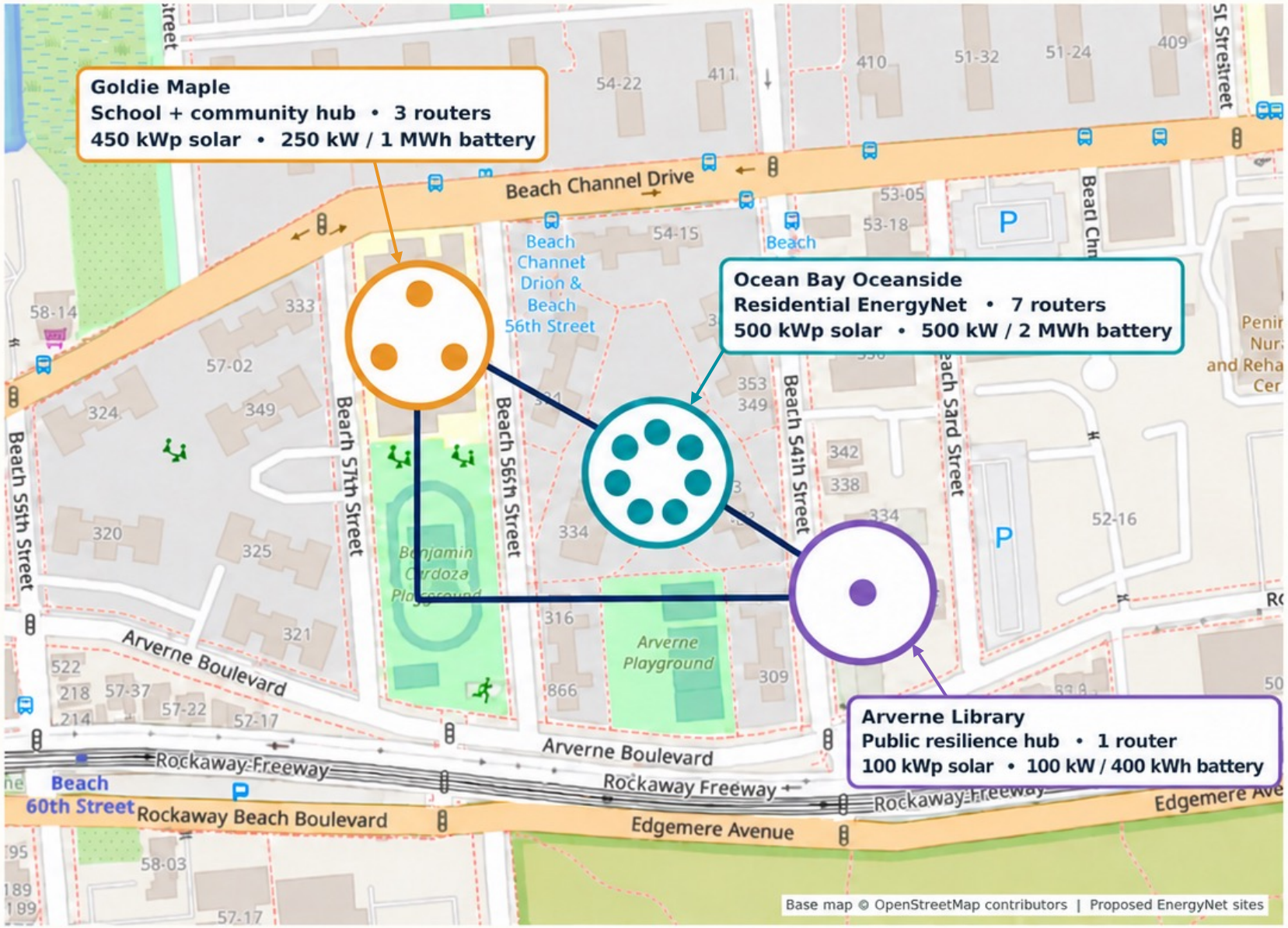


100%
critical demand served

12 hours
without grid connection

37%
battery state-of-charge remaining

Study Connecting three EnergyNets

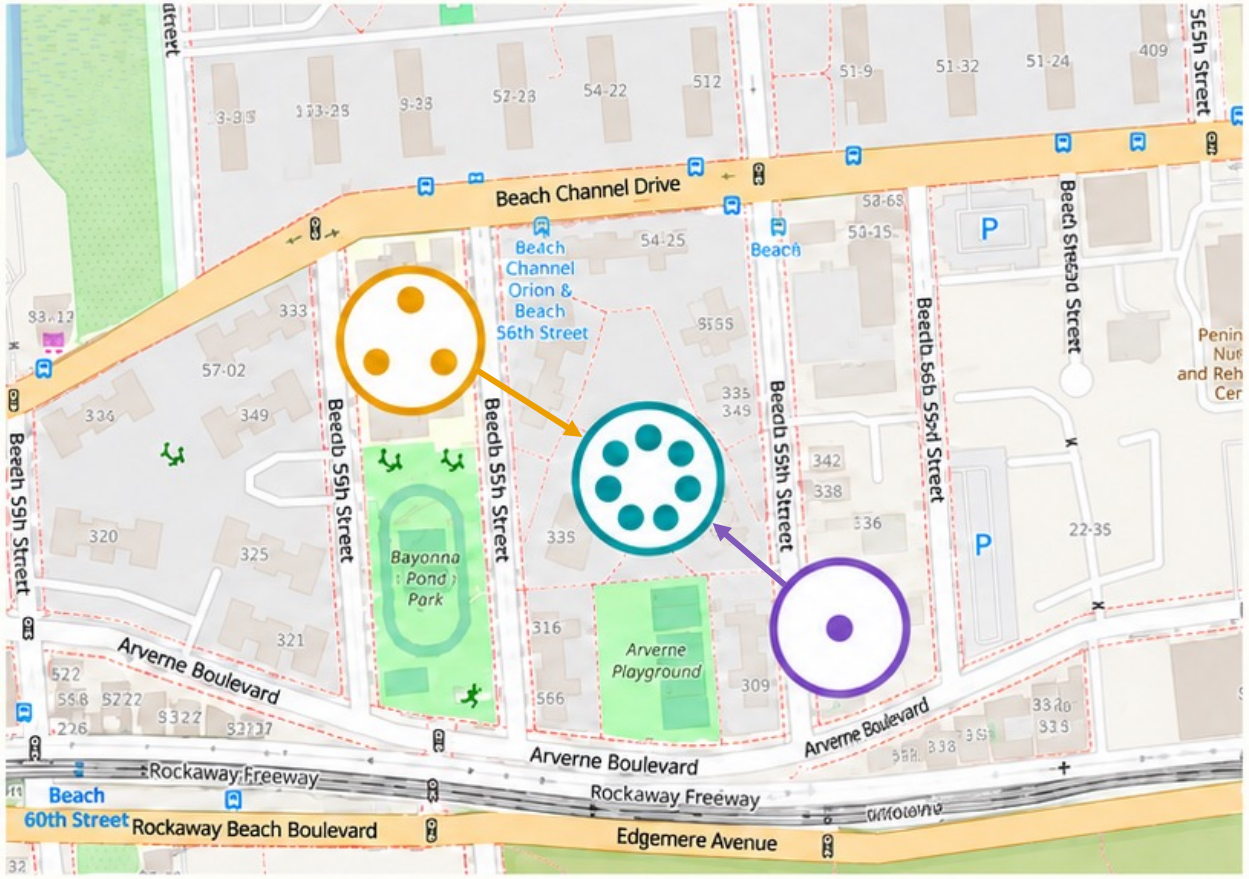


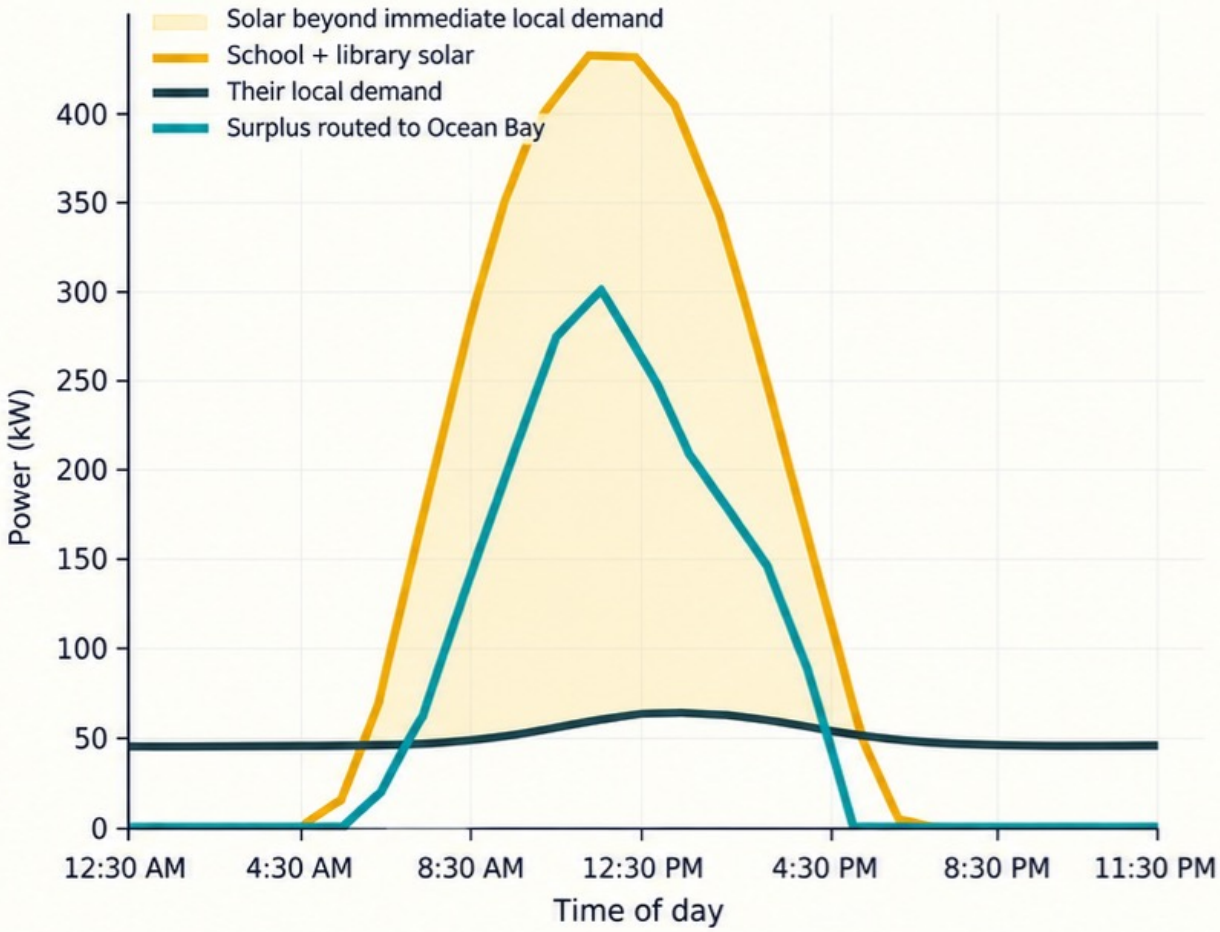






Three EnergyNets Routing and utilizing solar surplus

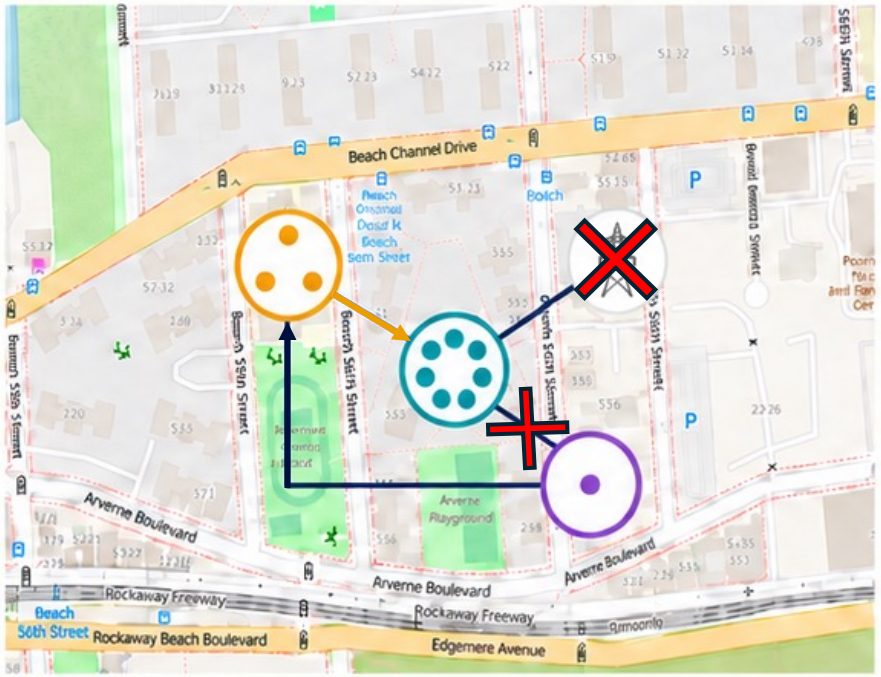


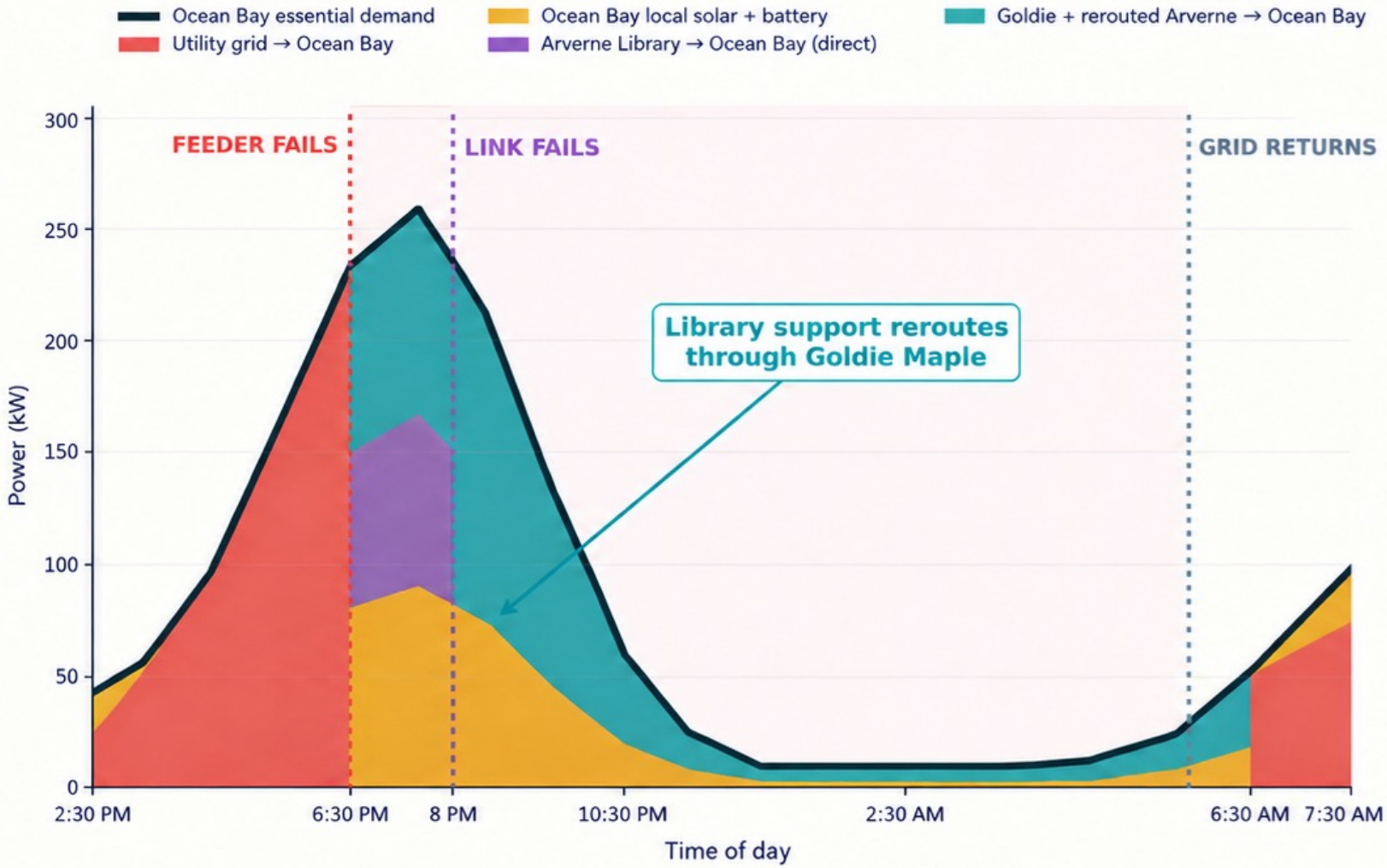


Some buildings have high solar generation but low demand (school building during weekend...)

EnergyNet permits energy sharing: 3.4 MWh less grid energy required/week

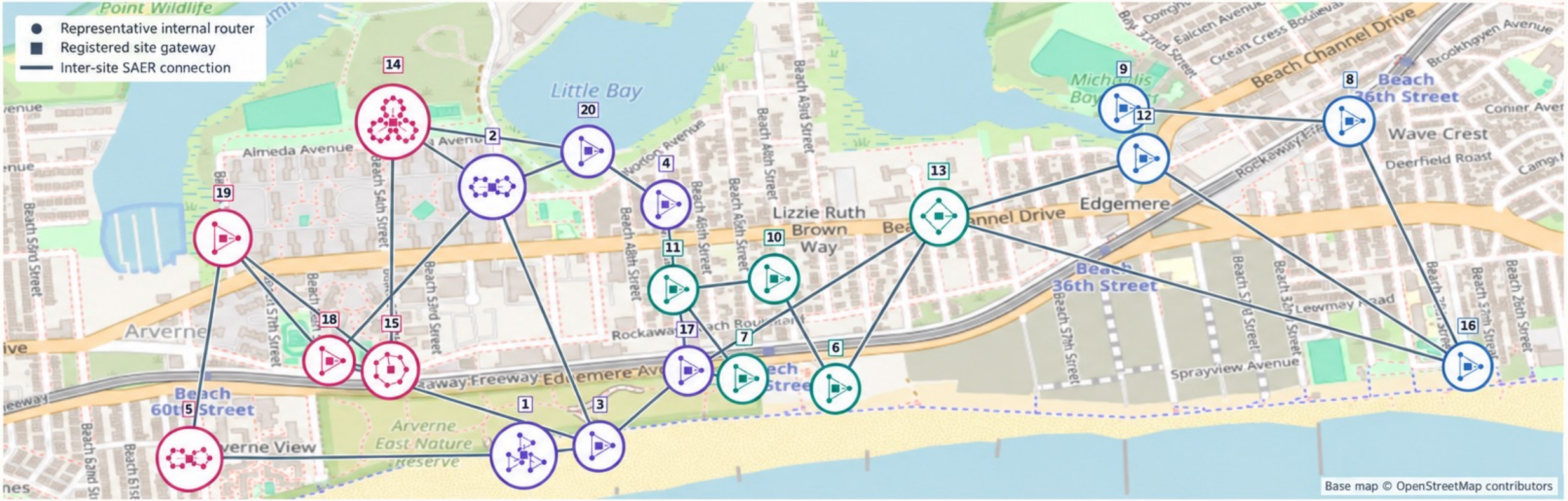
Three EnergyNets Resiliency by re-routing during grid outages





Ocean Bay essential demand remains 100% served

SAER from local EnergyNets to Rockaway-wide energy system



WEST RESIDENTIAL

5	Arverne View
14	Ocean Bay Bayside
15	Ocean Bay Oceanside
18	Arverne Library
19	Goldie Maple

CENTRAL DEVELOPMENT & CRITICAL

1	Arverne East
2	Edgemere Commons
3	50-01 RBB
4	Rockaway Care
17	EMS 47
20	PS 105

MID-CORRIDOR

6	La Quinta
7	Seaview Manor
10	BGD I
11	BGD II
13	Beach 41st

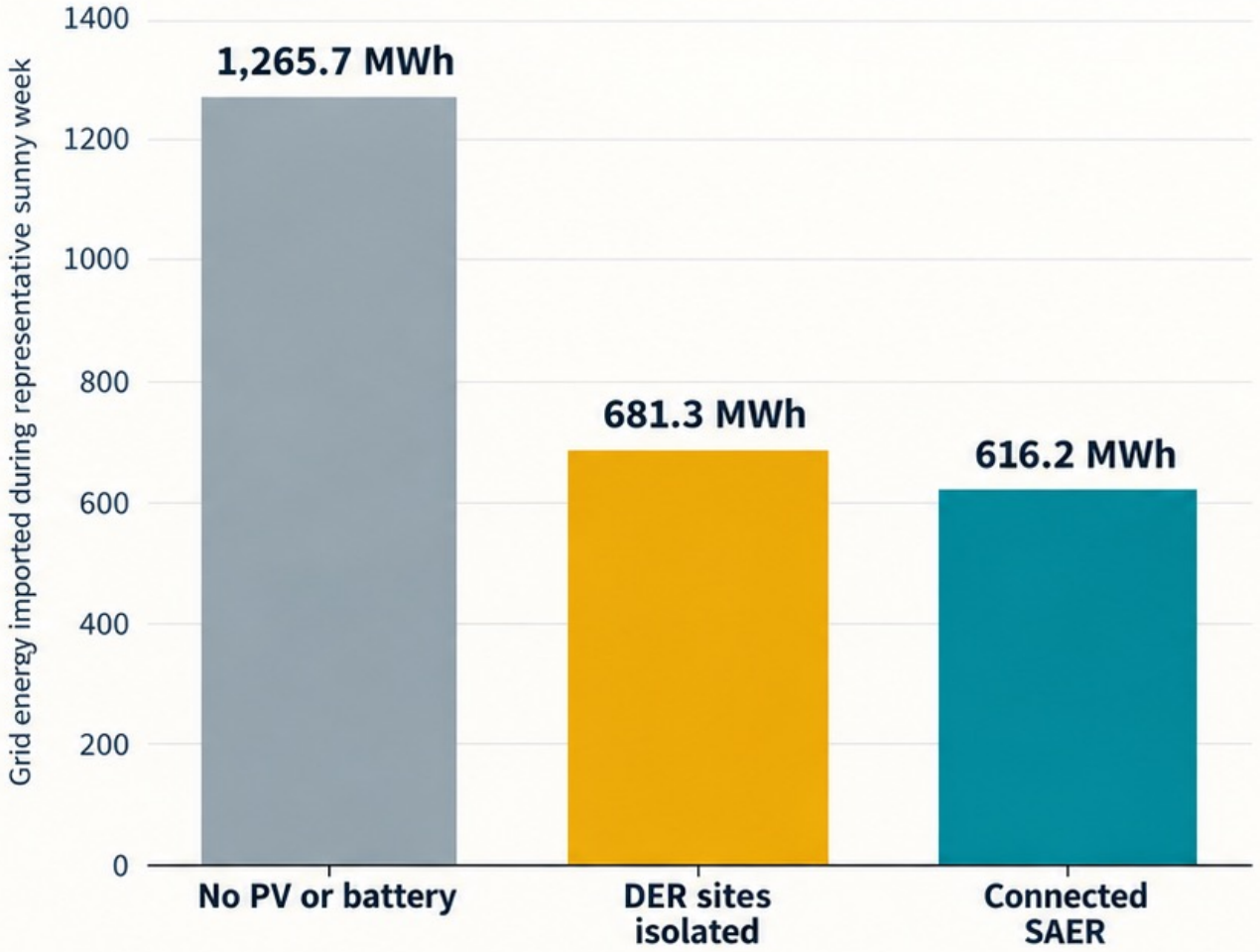
EAST

8	Seaview Towers
9	Seagirt Senior
12	BGD III
16	PS/MS 43

20 EnergyNets | **83** Energy Routers | **28** Inter-site connections

Internal diagrams illustrate the site EnergyNet architecture.

SAER from local EnergyNets to Rockaway-wide energy system



51.3%

lower grid energy imports

1,265.7 → 616.2 MWh

12.9%

lower peak grid draw

18.89 → 16.45 MW

2.44 MW reduction

99.5%

of available solar used

95.3% less curtailment

+9.5%

additional import reduction through inter-site energy sharing

versus the same DER sites operating independently

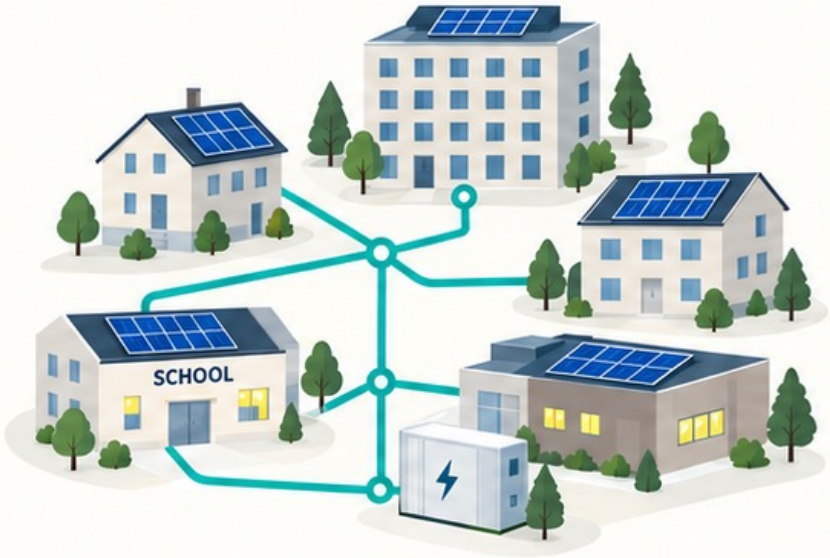
Across the full network, SAER reduces grid energy and peak demand while making use of almost all available solar.

How EnergyNet responds to a prolonged regional outage

Stress test: prolonged winter outage with the regional grid unavailable

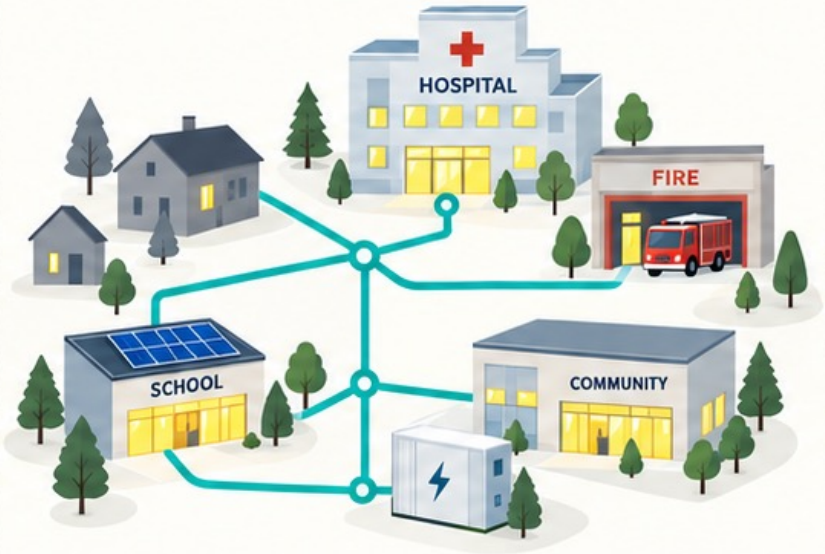
Share → **Prioritize** → **Reinforce**

1. Stationary EnergyNet



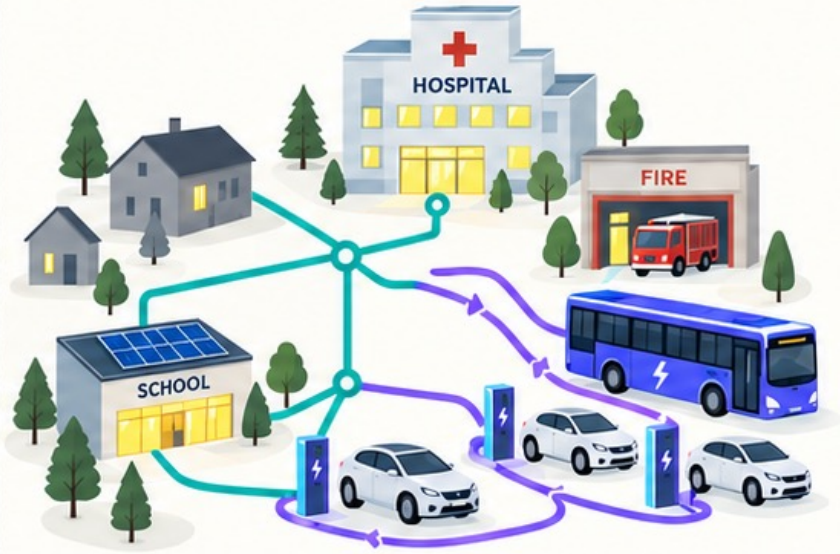
Share available solar and stored energy across the network

2. Emergency operation



Protect priority services and reduce non-essential demand

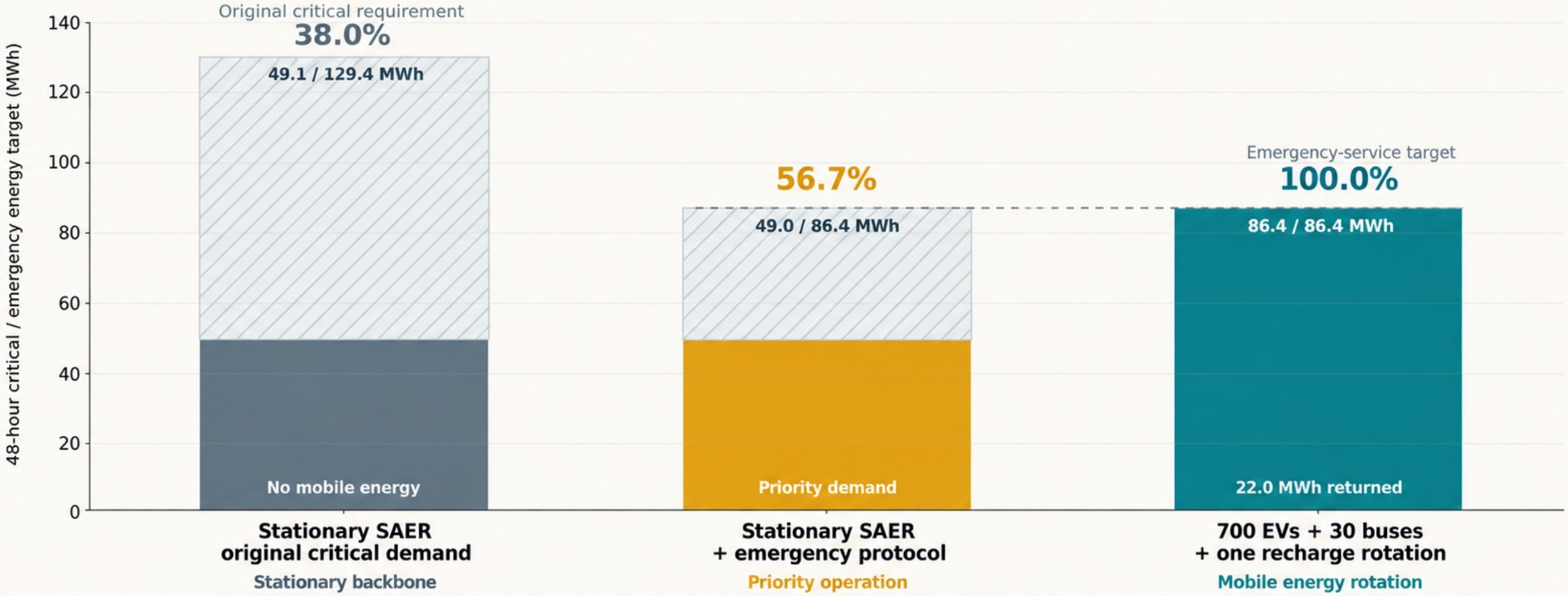
3. Mobile Energy Peering



Use EVs and buses to close the remaining winter energy gap

The stationary EnergyNet establishes the resilience backbone. Emergency operation protects essential services, and mobile storage supplies the remaining energy.

48-hour regional outage mobile energy closes the resilience gap



The stationary SAER provides the backbone, emergency operation protects priority services, and a rotating mobile fleet supplies the remaining winter energy.

Lowest-solar winter 48-hour window · regional grid unavailable · vehicles recharge beyond the outage boundary and return

Tack!

max.collins@viaeuropa.net
+46 709 10 20 95