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Carbon Footprint Management and kWh-Harvesting™ with Aciex Pulse© | Advancing the E in Proactive Corporate ESG

White Paper – October 2021

By Chas Anders Hall and Theo Breitenstein

executive summary

Emacx Systems, Inc. has developed, field-tested, and launched for commercial operation, a powerful, robust and unique actionable kWh-Harvesting™ and Carbon Footprint Monitoring control strategy tool, the Aciex Pulse© Platform.

Aciex Pulse delivers verifiable carbon footprint reduction.

By engaging the Aciex Pulse© "kWh-Harvesting™" protocol and strategy, Aciex Pulse© can consistently deliver verifiable real-time carbon footprint determinations and persistent building performance optimization leading to resultant savings and carbon footprint reductions. The Aciex Pulse© application platform has an extensive field-proven foundation reinforced by EMACX Systems' long-term in-depth facility operations experience and industry-recognized proven technical capabilities.

The Aciex Pulse© Platform is an essential and invaluable element of the strategy necessary to successfully transition the existing conventional building stock to high-performance operations mandated for sustainable buildings of the future.

Aciex Pulse© has consistently demonstrated the robust capabilities to:

- **Quantify and assess building GHG (greenhouse gas) emissions in real-time.**
- **Make legal energy source contributions limits and specific contributors immediately visible.**
- **Accomplish full energy use transparency from the building level down to individual meter levels, across billing cycle, year, and variable compliance periods.**
- **Calculate and forecast building year-end carbon footprint and associated penalties or surpluses across any compliance period.**
- **Identify high-energy consumption meters/tenants/users for targeted monitoring or management directed reductions.**
- **Facilitate targeted kWh and kW reductions or noncompliance gap closure scenarios.**
- **Enable at-will facility carbon emissions reporting and audit requirements.**
- **Improve tracking and performance reporting that are very necessary for corporate environmental social policies and publications.**

introduction

Over the last decade, corporations have been under the persistent directive to elevate their current building operations to high-performance sustainable profiles acknowledging the tenets of "You can't manage what you don't measure" interlocked with "You can't optimize what you don't manage".

Climate Mobilization Act calls for carbon footprint reductions of 40% by 2030 and 80% by 2050.

Climate change is requiring more rigorous and extreme energy consumption budgets required to deliver acceptable indoor environmental conditions all the while operating under pandemic constraints. What was a normal 18 days of 90+ Degree F weather will become 45 - 60 days of such elevated temperatures in the next 30 years. This realignment of facility operating conditions and limits will require an even more intensive existing facility performance over extended periods.

Corporate ESG (Environmental, Social, Governance) reports are now prerequisites in establishing a public-spirited presence.

Innovative tactical tools and actionable methodologies are indispensable in meeting the directives and challenges of carbon footprint management and reductions mandated by legislation or corporate policy embedded in ESG statements.

This trend has been enforced by authorities nationwide with new carbon emission laws. One of the most consequential of these carbon reduction laws is Local Law 97 in New York City. It forces companies to be comprehensively proactive in reducing their carbon footprint and subsequent contribution to global warming.

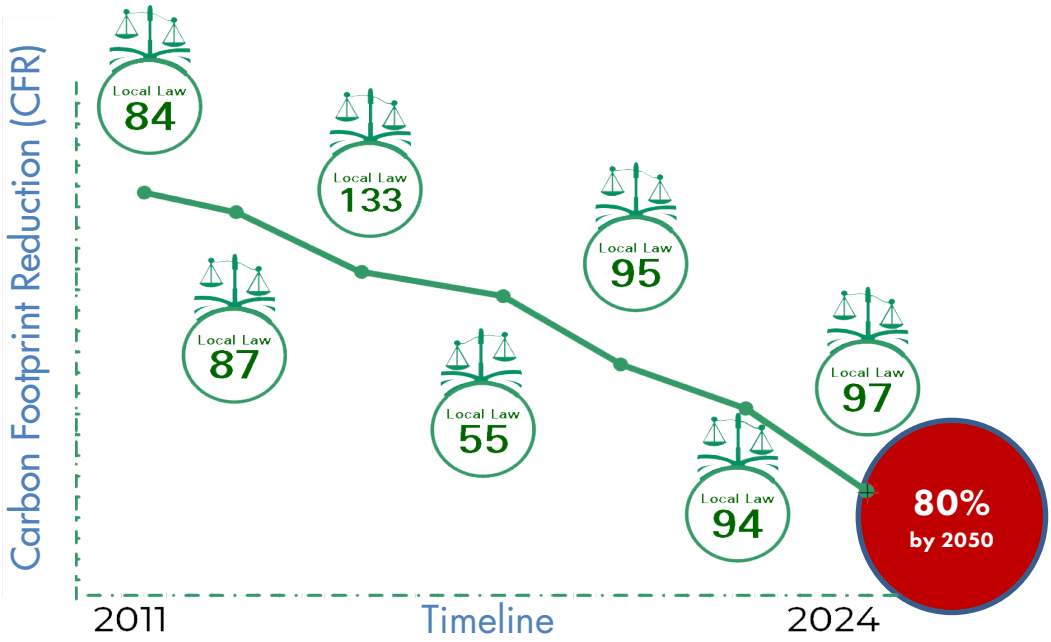
To provide building operations with the right capabilities, Emacx Systems Inc. developed a powerful **kWh-Harvesting™** and unique carbon footprint monitoring and management platform. **kWh-Harvesting™** is the systematic, continuous identification and prevention of excess electrical energy consumption expended in the delivery of HVAC load assets and facility operations in the built environment. Energy consumption inefficiencies of such assets are reduced and optimized without compromising operations and comfort at any given time.

Aciex Pulse© provides carbon footprint management and irrefutable legislatively ordered performance data in real-time along with the mandatory reporting for any yearly ongoing compliance and executes the smart and patented (patent pending) control strategy to realize and guaranty building wide savings.

the challenge

In 2019, New York City passed the Climate Mobilization Act, one of the most aggressive and rigorous carbon footprint reduction laws in the US. Local Law 97, the centerpiece of 2019's Climate Mobilization Act, calls for carbon footprint reductions of 40% by 2030 and 80% by 2050, affecting more than 50,000 buildings in NYC. Not meeting these strict greenhouse gas (GHG) emission standards will result in penalties of $268 per metric ton of CO2 over the mandated limits. If left unaddressed, the fines could reach hundreds of thousands of dollars per building each year. **Thirty-five cities in the US have announced plans to follow suit with similar carbon footprint laws.**

NYC Climate Mobilization Legislation Timeline



Building owners and operators are asking the question. What is the approach to mitigate potential greenhouse gas fines? What are the Energy Conservation Measures (ECMs) one should put in place, and what are the lowest hanging fruits for kWh reduction? All of these strategies are geared towards reducing the facility's carbon footprint.

To successfully implement a reliable and efficient carbon footprint management and reduction program, ownerships need to methodically address comprehensive energy usage and the changing composition of energy from the electric grid. This undertaking requires a "next level of energy management and efficiency" to mobilize significant reductions in facility energy intensity well beyond historical practice.

Corporate carbon footprint goals along with the more rigorous legislated carbon emissions limits have a momentous impact on building operations. Building owners need new means and methodologies to accurately monitor compliance, such as:

- Real-time verifiable and unimpeachable carbon footprint computations including contributions by the individual system, user, and location.
- Certifiable facility carbon footprint projections against corporate goals or legislated allowances.
- Immediate and transparent actionable compliance accounting and direction.

the solution

The five most significant challenges to verifiable ambitious carbon footprint management are:

1. The amount of energy usage must decrease, in most cases, dramatically.
2. Energy efficiency sources and reductions must be diversified.
3. Reliable Measurement and Verification (M&V) for energy reductions must be trustworthy and visible.
4. Energy efficiency achievements and savings must be integrated into a carbon reduction framework.
5. Energy reductions and changing user profiles must be part of the evolving electric distribution grid, integrating renewables, distributed energy resources (DERs), and intelligent load management.

Energy efficiency achievements and savings must be integrated into a carbon reduction framework.

The application of the **Aciex Pulse**© carbon footprint management platform provides ownerships and property managers extraordinary capabilities absolutely necessary when addressing the complexity and financial impacts of carbon footprint allowances demanded by government legislation or corporate social mandate.

overview

Aciex Pulse©, at a keystroke, provides these mandatory and crucial high-performance facility deliverables:

- At-will recognition of facility or portfolio carbon footprint position.
- Immediate time-stamped consumption data and associated carbon footprint implications.
- Projected carbon emissions at year-end including multi-year historical baseline carbon profiling for facility operations evaluation.
- Elimination of current labor-intensive data preparation and manual report preparation.
- Real-world predictions based on application-proven forward-looking algorithms.
- Provide programmed dynamic mitigation strategies.
- Illustrate the impact of mitigation strategies formulated or employed.

- Allow multi-facility comparison with aggregated performance matrix.
- Provide the ability to partition discrete carbon footprint contributors such as processes or tenancies.
- Delivers forecasting for anticipated below allowance carbon cap and trade market.
- Eliminate the complexity of generating analysis and partitioning for multi-tenant building and penalty allocation for portfolio owners.

Aciex Pulse© delivers forecasting and what-if scenarios.

Aciex Pulse Management Report LL97 Metrics – Energy Consumption Profiling				
Energy Type	**YTD**	**Projected Year-End**	**YTD (kBtu)**	**Projected Year-End (kBtu)**
Utility Electricity	**6,158,186**	**27,081,178**	**21,012592**	**92,404,768**
Natural Gas (therms) **#2 Fuel** **#4 Fuel** **(Gallons)**	**171,897**	**755,933**	**17,189,700**	**75,593,356**
District Stream (mlbs)	**7,183**	**31,590**	**8,577**	**37,718**
		Total Energy Used (kBtu)	**38,210,868**	**168,035,744**

LL84/95 Metrics: Energy Use Intensity (Un-Normalized)
Site EUI: 63.6 KBTU/Sq. Ft.
Source EUI: 128.1 KBTU/Sq. Ft.
GHG Emissions Intensity: 4.49 $KgCO^2$ /Sq. Ft.

Aciex Pulse© platform with its granular energy consumption tracking capability incorporates seamless integration with any existing Building Management System on the market. The integrated **Aciex Pulse©** platform will provide operators of commercial buildings, hospitals, universities, and other facilities with the means to monitor their current carbon footprint position and project year-end target compliance and goals. **Aciex Pulse©** also provides a best-of-class proactive approach to reduce CO^2 emissions accomplished through ongoing facility performance optimization without sacrificing environmental quality.

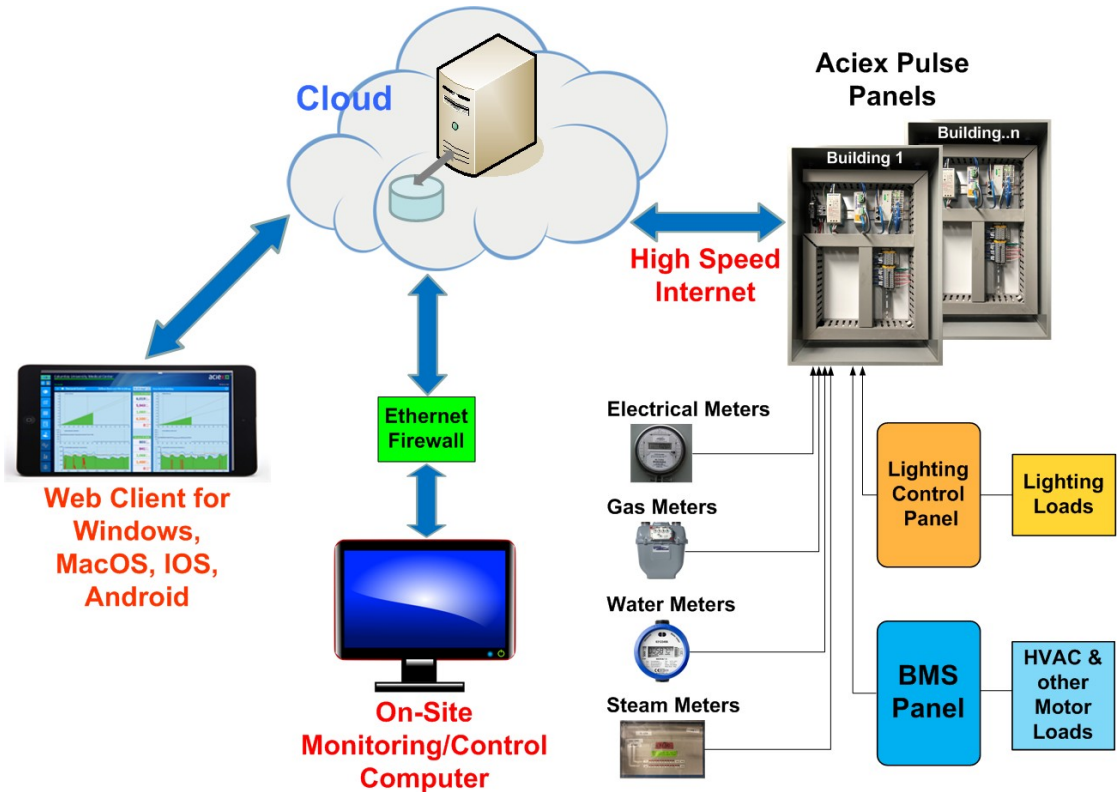
Aciex Pulse© continuously delivers these valued emissions reductions by implementing its proprietary optimization technique of **"kWh-Harvesting™".**

kWh-Harvesting™ is an Emacx Systems developed sustainability strategy executed by **Aciex Pulse©** to:

kWh-Harvesting is a sustainability strategy executed by Aciex Pulse©.

- Capture the "wasted" usage of kWh of load assets stemming from universally recognized inherent systems overdesign, or overly conservative systems operations.
- Optimize energy asset loads that are pointlessly running at 100% capacity 24/7.
- Capitalize on recalibration optimization of operations during non-peak conditions, and ambitiously taking advantage of seasonal and hourly weather variations.
- Enhance operating efficiencies of energy-consuming load assets with additional controls such as VFDs.
- Take advantage of load shifting and scheduling.

Typical System Architecture



The facility integration of the **Aciex Pulse© kWh-Harvesting™** is extraordinarily transparent and begins with a thoroughly detailed facility evaluation process. A meticulous granular load study, investment-grade in scope and deliverable, is completed. Appreciable electric-consuming load assets that could potentially qualify for the **kWh-Harvesting™** technique, such as variable speed pumping capability, are identified. All operating parameters of these assets are codified and documented.

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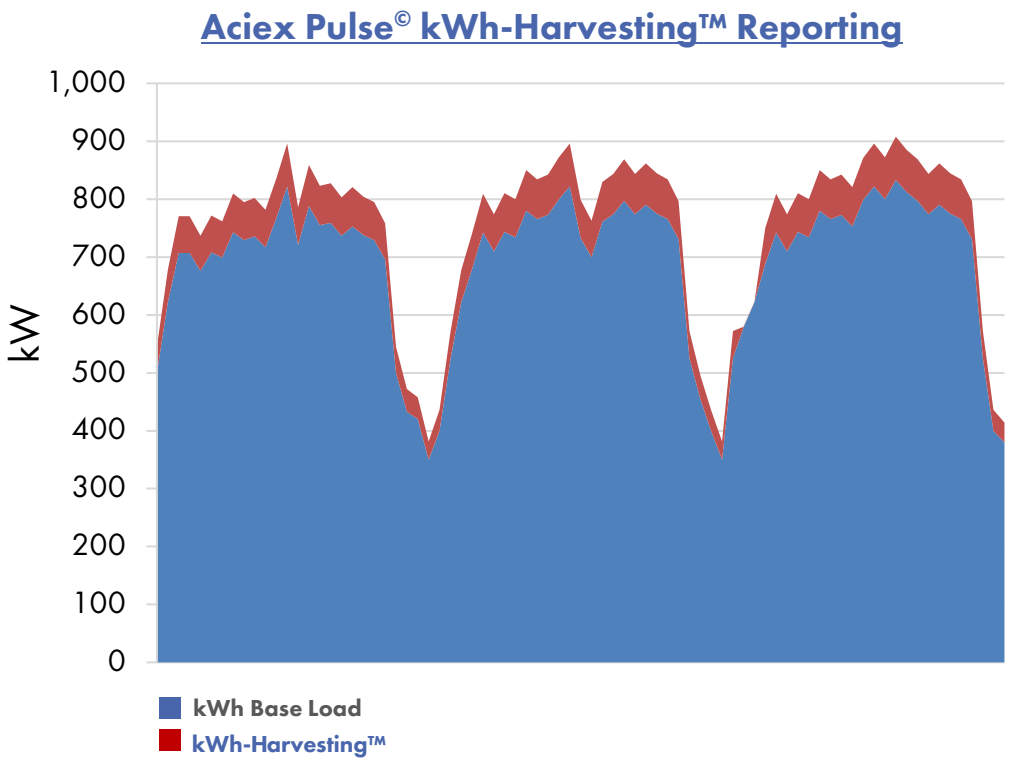
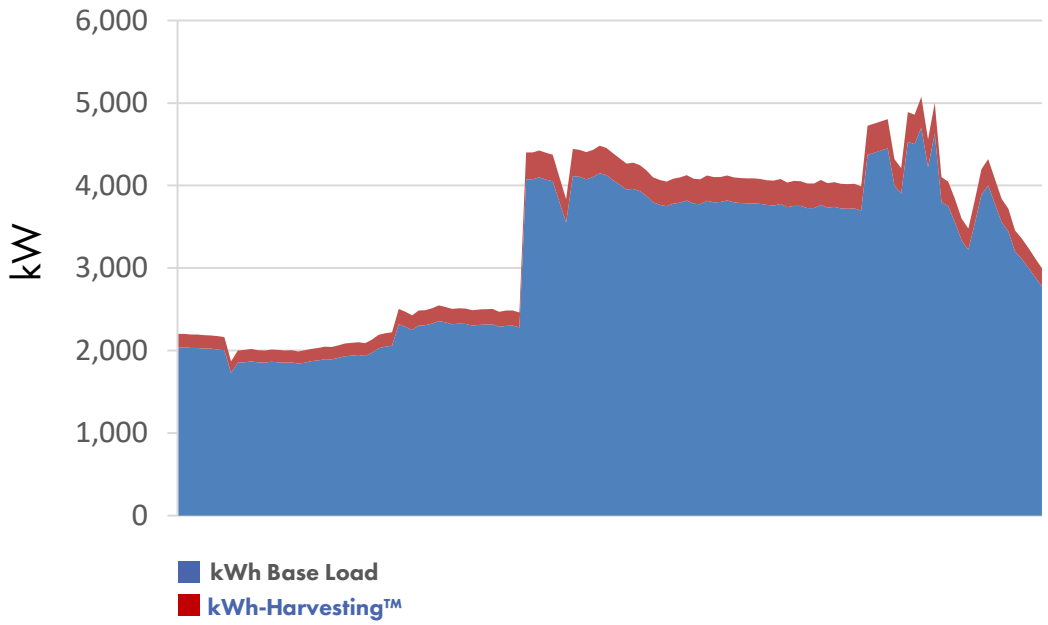


These pre-qualified selected load reduction resources are registered into the **Aciex Pulse©** platform and assigned to the **kWh-Harvesting™** protocols. Through a proprietary innovative forward-looking feedback analysis, the **Aciex Pulse©** identifies at any given time how each load is specifically performing (such as speed %, HZ, kW,…) and what load reduction potential is possible as a result of facility real-time environmental coincidental data retrieved from the BMS interface.

Aciex Pulse© kWh-Harvesting™ Reporting Load Profile



Once the load assets that qualify for **kWh-Harvesting™** are identified and selected, the time-stamped sustainable kW reduction from each load is determined and activated with targeted facility operations acting as the maintained IEQ (Indoor Environmental) reference point. The aggregation of each kW reduction achieved, coupled with the associated **kWh-Harvesting™** period of that reduction will determine the ongoing real-time reduced kWh accumulation being achieved at any instant and cumulative from any point of reference or overall period.

It is important to emphasize that all the considered loads selected and prompted for **kWh-Harvesting™** are connected, monitored and unconditionally controlled by the operating requirements of existing facility BMS. **Aciex Pulse©** only suggests target operating parameters fully in compliance with what the BMS dictates.

an actual installation

Once the **kWh-Harvesting™** carbon footprint reduction objectives are authorized by facility operations, guided by year-end projections, and the amount to harvest from each load is determined, the loads are prioritized and organized into groups. The priority indicates the order in which the loads are activated for **kWh-Harvesting™**. The lower the priority, the earlier the load will be harvested. The groups are formed with loads to create uniform entities that will provide comparable amounts of kWh that can be harvested.

To assure the determined **kWh-Harvesting™** amount necessary for the carbon footprint reduction sought after, each load group will have more usage reduction potential available for collecting than required.

Each group of loads is on a rotating schedule activated for shedding for 15 minutes (time adjustable) and then reconnected for 15 minutes. If there are more than two load groups, each load group is activated less often for **kWh-Harvesting™**. Each group can be assigned a different time duration for **kWh-Harvesting™** and reconnection.

In general, the more individual loads that are available for **kWh-Harvesting™,** the higher the energy reduction, the more load groups can be formed, and consequently each load group, due to the rotation schedule, is less often activated.

In summary, the unique and smart **kWh-Harvesting™** control methodology of **Aciex Pulse©** allows for significant kWh and carbon footprint reduction without compromising operations or comfort at any given time.

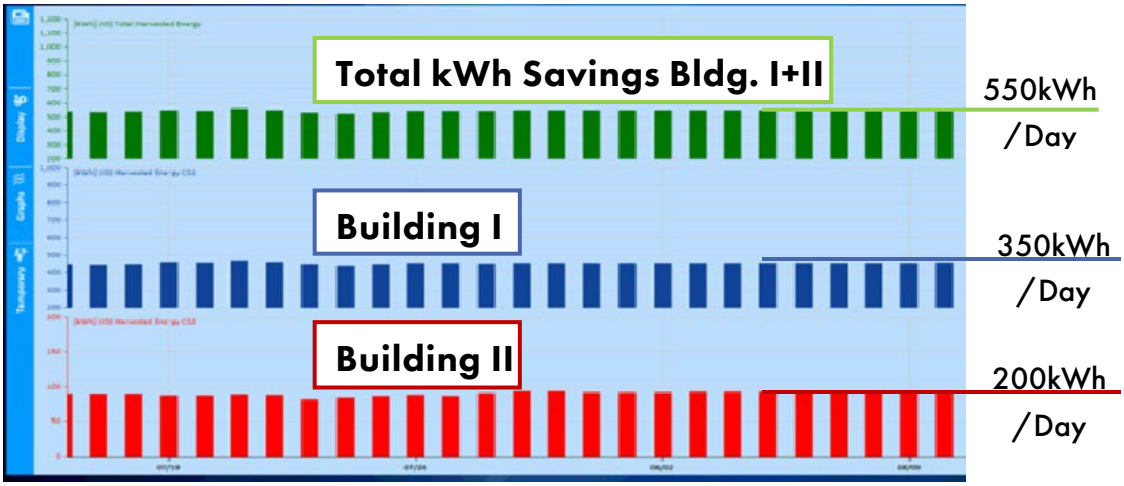
The smart control methodology of Aciex Pulse© allows for significant kWh-Harvesting™ .

The unique and smart **kWh-Harvesting™** control methodology of **Aciex Pulse©** fully integrated into the Building Management System (BMS) *(see Typical System Architecture Graph)* allows for significant savings without compromising operations or comfort at any given time. The forecasted **kWh-Harvesting™** and carbon footprint reduction for a small NYC Hospital was 140,160 kWh, an equivalent of 40.5 tons CO^2. After commissioning and a thorough M&V the key savings metric for before and after are as follows:

Key Savings Metrics Forecasted vs. Actual

Measure	*Forecasted Savings*	*Actual Savings*
kWh-Harvesting	140,160 kWh	183,850 kWh
CO2 Reduction	40.5 tons	53.1 tons
LL97 Mitigation Value	$10,856	$14,240
Total Savings per Year	***$34,176***	***$40,898***

kWh-Harvesting™ Savings M&V Window Aciex Pulse



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in closing

Aciex Pulse© is the industry's only real-time, next-generation strategy for kWh-Harvesting™ and carbon footprint management solution. Aciex Pulse© fully automates the assessment, compliance, reporting administration, and mitigation capability requirements to meet corporate carbon footprint goals or legislated carbon emission allowances with associated penalties. There is no silver bullet or magic wand. It is the ongoing discreet deliverable steps by Aciex Pulse© that will meet the mark to answer all the challenges of climate change.

Aciex Pulse© the answer to carbon footprint management and automatically supplies all the best practices of carbon footprint reduction for the truly intelligent high-performance facility.

Aciex Pulse© delivers a very economical financial return on investment (FROI). It also generates a world-class societal return on investment (SROISM).

Aciex Pulse© is the industry's only real-time, next-generation strategy for kWh-Harvesting™ and carbon footprint management solution.

about the authors

Chas Anders Hall, PE CEM LEED AP O&M GPCP:

Mr. Hall is a highly credentialed professional with over 45 years in energy efficiency and sustainability program development and delivery for the built environment. He has held many C- suite responsibilities including president of the US subsidiary of a premier UK ESCO, as well as, the CEO of a Washington DC SDVOSB ESCO successfully serving the US government. He is an acknowledged speaker and teaches all the Green Professional (GPRO) courses for Urban Green Council, Building Operator Certification (BOC) I & II for Northwest Energy Efficiency Council (NEEC), green courses for 32BJ and seminars on the NYC Climate Mobilization Act (LL97) for NYC Building Energy Exchange (BEEx).

Theo Breitenstein, MBA CEM CDSM CSDP:

Mr. Breitenstein is President and Founder of EMACX Systems, Inc. and Aciex LLC. He is a pioneer in bringing advanced demand side management technology to the US. With his expertise and passion for energy conservation, he founded Emacx Systems, Inc. in December 2001 to serve the US market with such technology. With over 28 years in the energy management and power industry sector, Mr. Breitenstein, through Emacx Systems, developed in recent years the new generation of advanced demand-side and microgrid management technology Aciex. For his outstanding work, Theo was honored with the "Energy Engineer of the Year" award for 2009" from the AEE NYC Chapter and in 2010 the AEE Regional award. In 2017, he received the highest honor with the AEE "International Energy Engineer of the Year" award.