Thermoelectric Generation System(TGS)

TGS Servers, Routers, Switches and how to transform the data center into a power generating center

What is a TGS?

- A TGS is any computing system or device in the enterprise data center with Thermoelectric technology integrated to generate energy from the waste heat or temperature gradient present from the normal work the system would conduct.

How does it work?

- TGS based device harvests, recycles or converts the waste heat energy from the components inside the device to generate DC electricity.
- The energy harvested can be re-applied to the same device to reduce its draw from the grid.
- The energy harvested can also be applied to other uses externally from the device that harvested it.
- We define the energy harvested as The Thermoelectric Generation System Offset Effect. TOE is the culmination of the offset energy generated from a system with Thermoelectrics integrated into it.

How much energy do you obtain?

- Depending on the configuration and operating conditions a single system can generate from 3-10 volts and 5 or more watts of power at a minimum continuously for the operational life of the system.
- With the advancements in Thermoelectrics 20+ volt systems are possible.
- Scaling this system can result in significant power generation.

Scaling of TGS devices

How do we scale?

TGSx - TGS Scaling Exponet

The multiplicative scaling of systems producing TOE energy in a data center.

Two definitions

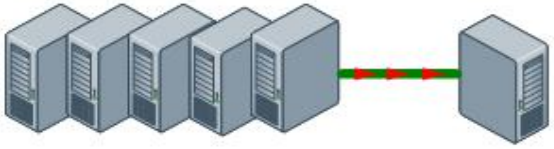
- The number of TGS servers required to be in operation to generate usable or surplus TOE power to power another TGS or non TGS device completely off grid.

- The number of TGS servers required to be in operation to generate usable or surplus TOE power to achieve a measurable ROI.

TGS^{x}

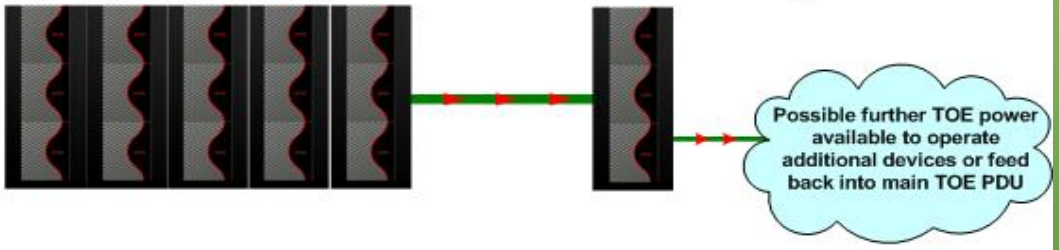
Non recursive external examples

TGS^{5} – 5 TGS servers produce enough TOE energy to power one (TGS or non TGS server).

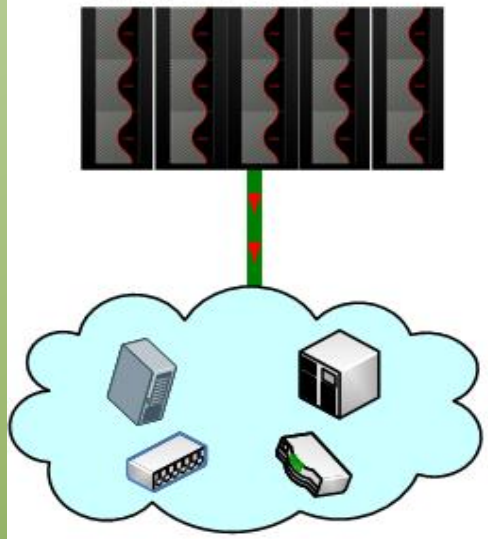


TGS^{100} – 100 TGS systems(xU servers, blade, etc., produce enough TOE energy to power another rack of servers.

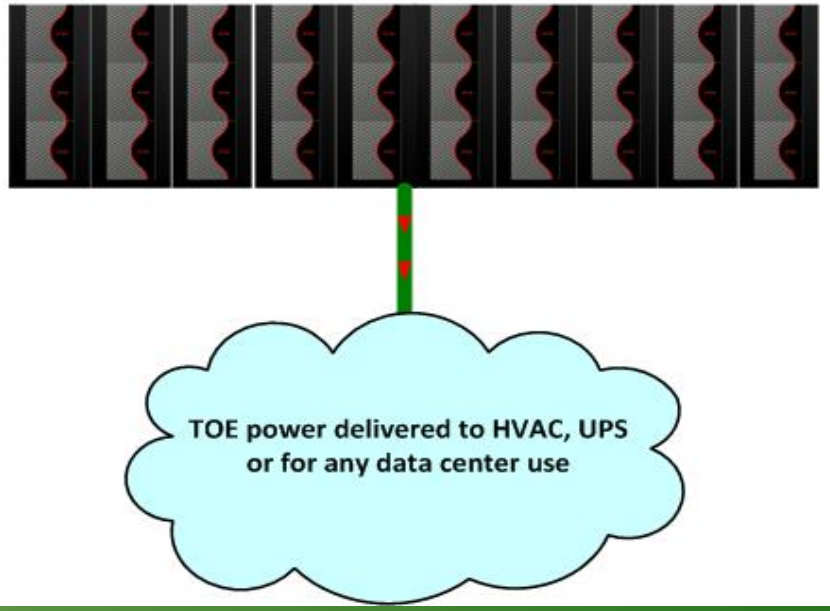
If this rack of servers are TGS based then they can also provide TOE energy as well.



TGS^{x} loose scaling conformity – a group of TGS devices providing TOE energy to power any number of data center devices, routers, switches, other.

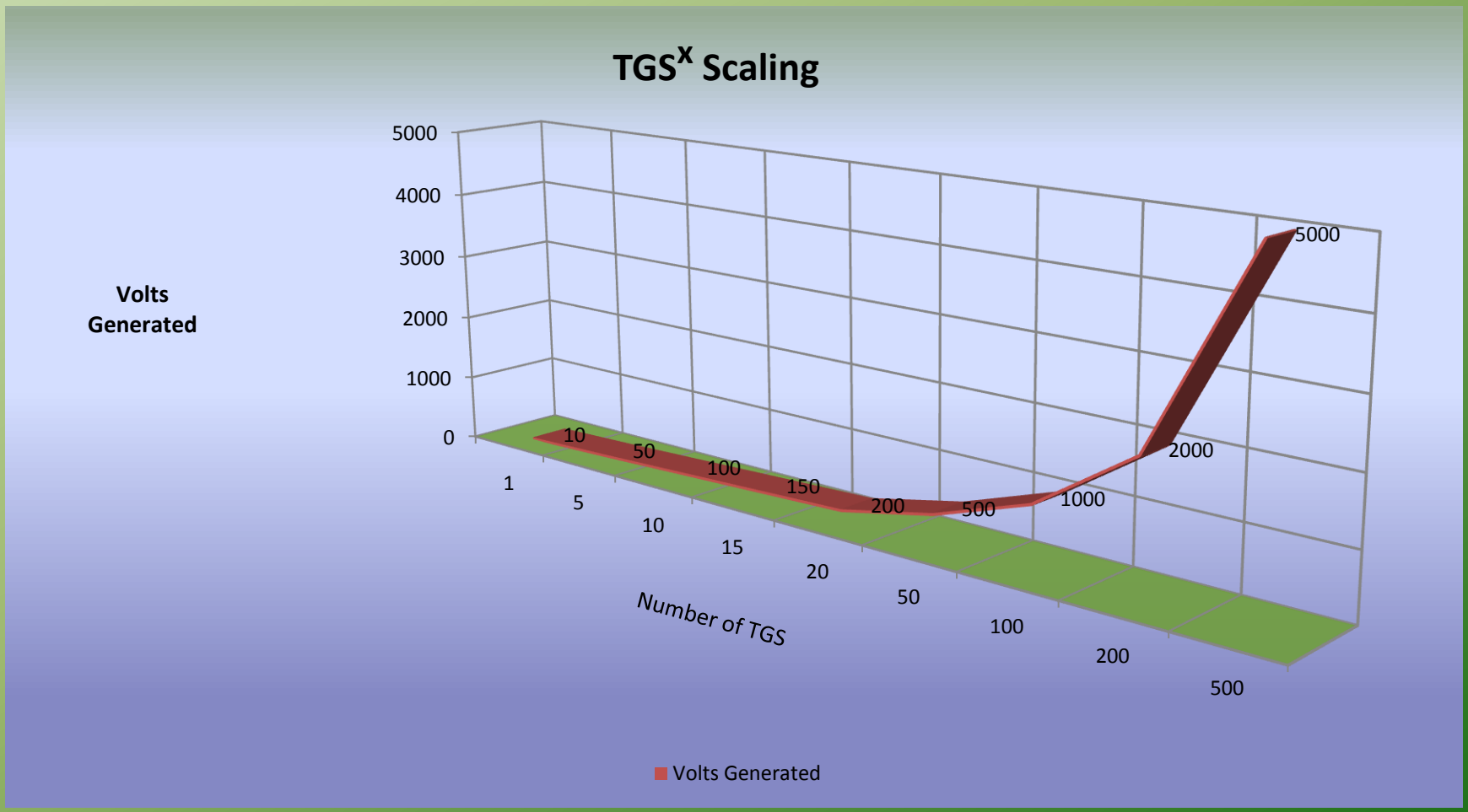


TGS^{500} – 500 TGS systems(xU servers, blade, etc produce enough TOE energy to assist in powering cooling systems or charging UPS systems completely off grid.



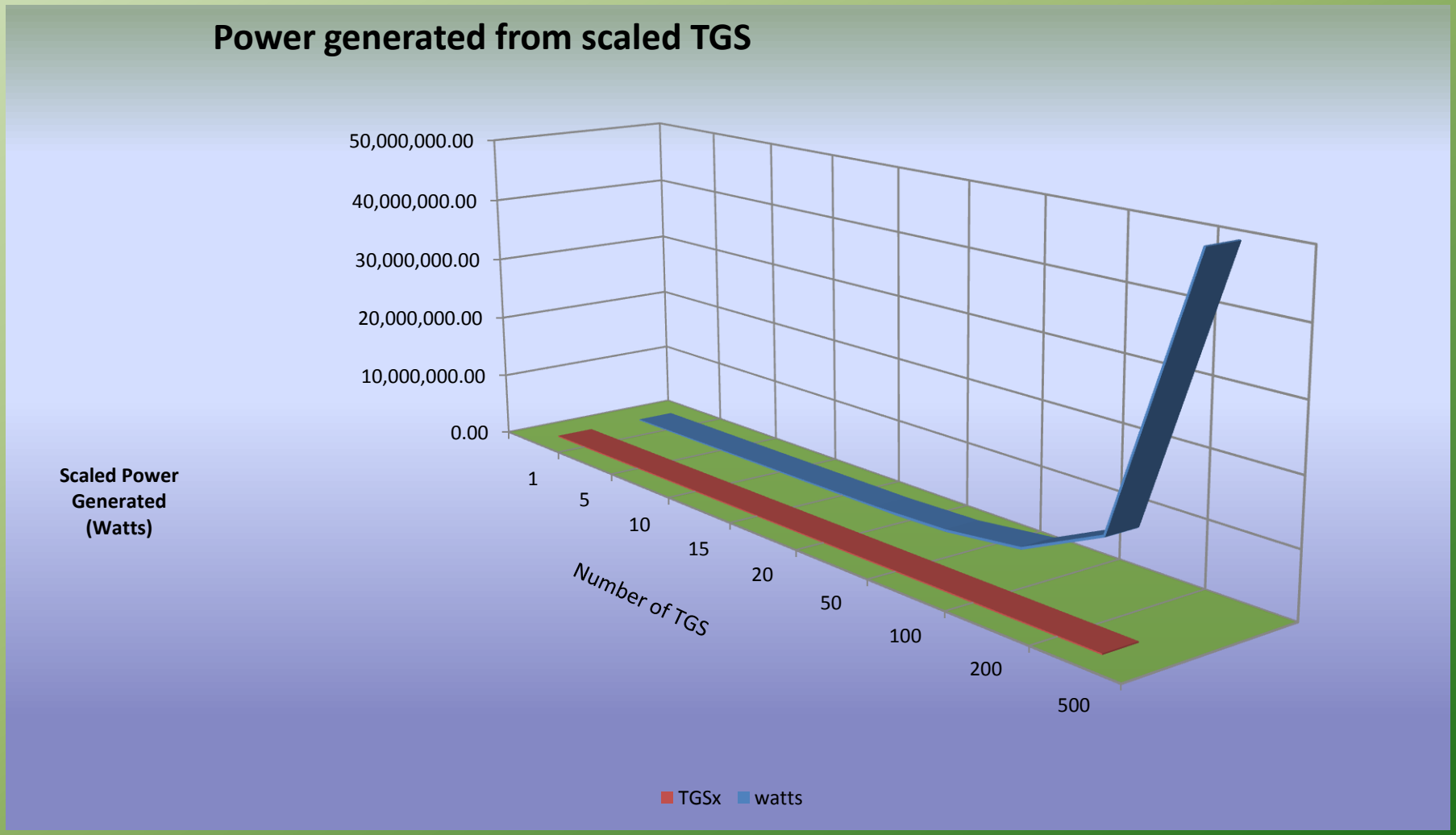
By scaling TGS servers an enterprise can generate significant amounts of usable off grid energy.

The graph below illustrates our upcoming 10v model when scaled.



Scaled power generation

The graph below illustrates our upcoming 10v model when scaled.



What can you do with the energy?

- Power other IT devices.
- Distribute into a larger pool for other uses in the data center for cooling, lighting or UPS charging.
- Anything you want with it but take over the world…

Why do this?

- To offset the cost of energy in the data center.
- To reduce energy consumption from the grid.
- To ultimately reduce monthly data center energy bills.
- To be green without the green hype(we are the quiet green).
- To contribute to the environment and help your country by using a sustainable and alternate form of energy production.

ROI and Value

- Savings or value of energy realized when TGS devices are scaled.
- kWh rates stated are at national average of .11¢
- Scaling can be inclusive from densely packed components inside blade and high performance computing systems which results in increase energy generation.
- Example below can be based on the number of 1u server units deployed

TGS	**High End manufactured version**
Scaled generation method	**10 volt model**
TGS TOE is networked	**VA apparent power**

High End TGS	volts	amps by 2 Ω int R	watts	kWh	avg kWh .11¢	Day	Month (x 30)	Year(day x 365)
1	10	5	50	0.05	$ 0.01	$ 0.13	$ 3.96	$ 48.18
10	100	50	5,000	5	$ 0.55	$ 13.20	$ 396.00	$ 4,818.00
50	500	250	125,000	125	$ 13.75	$ 330.00	$ 9,900.00	$ 120,450.00
100	1,000	500	500,000	500	$ 55.00	$ 1,320.00	$ 39,600.00	$ 481,800.00
250	2,500	1,250	3,125,000	3125	$ 343.75	$ 8,250.00	$ 247,500.00	$ 3,011,250.00
500	5,000	2,500	12,500,000	12500	$ 1,375.00	$ 33,000.00	$ 990,000.00	$ 12,045,000.00
750	7,500	3,750	28,125,000	28125	$ 3,093.75	$ 74,250.00	$ 2,227,500.00	$ 27,101,250.00
1000	10,000	5,000	50,000,000	50000	$ 5,500.00	$ 132,000.00	$ 3,960,000.00	$ 48,180,000.00
2000	20,000	10,000	200,000,000	200000	$ 22,000.00	$ 528,000.00	$ 15,840,000.00	$ 192,720,000.00
5000	50,000	25,000	1,250,000,000	1250000	$ 137,500.00	$ 3,300,000.00	$ 99,000,000.00	$ 1,204,500,000.00

Our systems contribution to energy efficiency in the data center

- Complements enterprise IT energy conservation and environmental efforts
- Reduces overall data center energy consumption and cost if TOE energy is reapplied. Savings can help reduce the cost of fuel or fuel delivery surcharges commonly applied to utility bills.
- Works with other alternative energy sources such as Solar and Wind, energy from TGS based devices can be supplied in line with DC from Solar and Wind sources
- Our approach and system helps IT departments contribute to a corporation's bottom line by acting as a producer and not only a consumer of resources.
- The approach to utilizing Thermoelectrics in the enterprise does not require the various cut backs as is applied to other green initiatives.
- Can be integrated as a tactical to strategic green initiative
- Mitigates costs resulting from server sprawl, especially if unavoidable. Energy costs attached to sprawled servers now reduced from TGS device energy availability.
- Helps increase the meltdown gap between computing and energy consumption as per Moore and Amdahl's law
- Increases period of time for the cost of energy to overtake the cost of the device in the data center

Our product offerings

- TGS Server in any platform form factor
- TGS Router in any platform form factor
- TGS Switch in any platform form factor
- TGS PDS - Power distribution system to connect all the TGS device in the data center to scale the energy produced

All products are forthcoming and video demonstrations will be available at www.amilabs.com/tgs

Summary

- The TGS series of data center devices provides another dimension to the enterprise data center – **Power Generation.**
- IT assets are now not only a consumer of energy but also a **producer.**
- While your data center is working for the enterprise in one manner it is also creating savings and value in another.