

# TPC-ENERGY LESSONS LEARNED IN PRACTICE

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# TPC-ENERGY SPECIFICATION

The TPC-Energy specification augments existing TPC Benchmark Standards

TPC-Energy provides energy metrics in the form “Watts per performance”,

e.g. watts/tpmC



# TPC-ENERGY STAGES

## CONFIGURATION

- Benchmark Configuration
- Reported Energy Configuration
- Power Measuring Unit
- PMU Substitution
- Power Analyzer Configuration
- Energy Measuring System Configuration

## EXECUTION & VALIDATION

- The Validation Run
- Report Generator
- Power Analyzer Calculations

## TUNING

- The Tuning Process
- Performance, Energy, Price combined metric
- Scaled PEP Volume Application



# STAGE ONE

## Configuration



# TPC-ENERGY

## CONFIGURATION

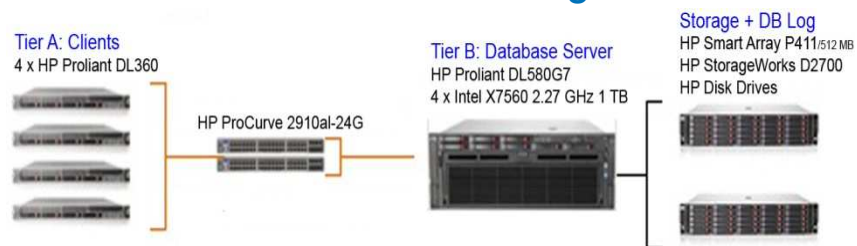
- Benchmark Configuration
- Reported Energy Configuration
- Power Measuring Unit
- PMU Substitution
- Power Analyzer Configuration
- Energy Measuring System Configuration



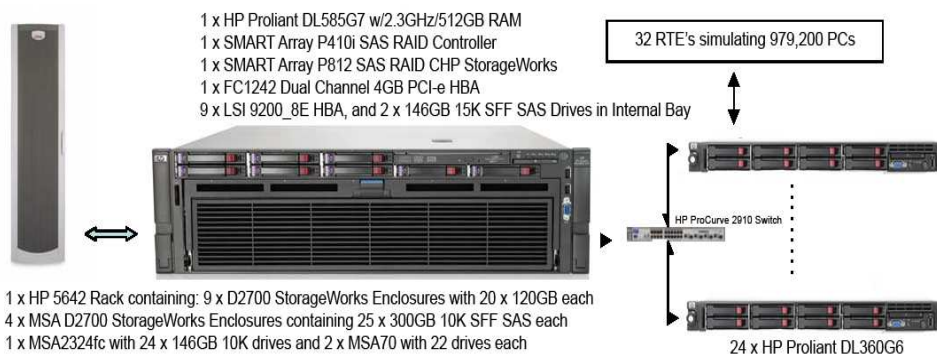
# BENCHMARK CONFIGURATION

## STAGE ONE

### TPC-E Benchmark Configuration



### TPC-C Benchmark Configuration

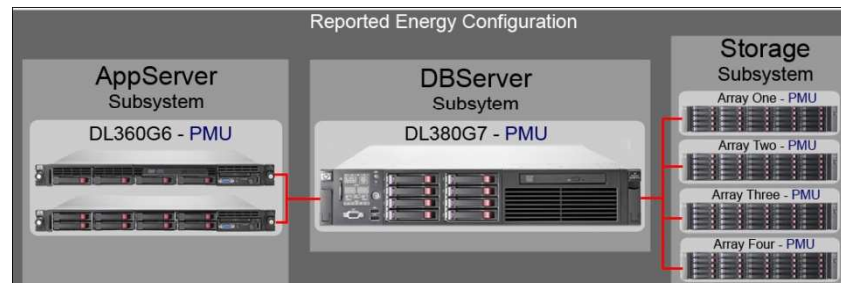


# REPORTED ENERGY CONFIGURATION

## STAGE ONE

The Reported Energy Configuration (REC) consists of all the components that participate in the energy measuring process and may be divided into subsystems, consisting of one or more Power Measurable Units (PMU).

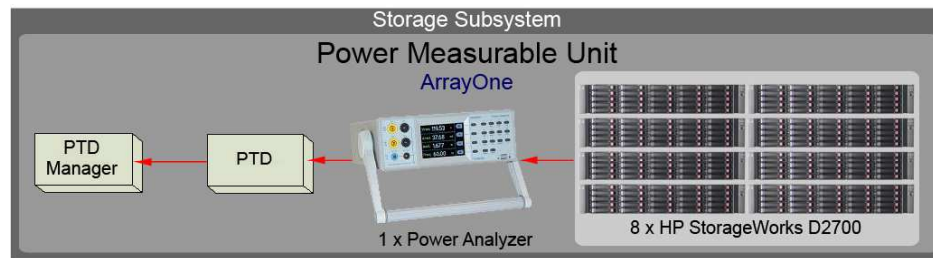
- Database Server Subsystem
- Storage Subsystem
- Application Server Subsystem
- Miscellaneous Subsystem



# POWER MEASURING UNIT

## STAGE ONE

The TPC-Energy specification, Clause 0.4, defines a Power Measurable Unit (PMU) as a component or collection of components of the REC which can be independently measured with a power analyzer.



- The ArrayOne PMU is a component of the DL380G7 REC's Storage Subsystem
- The ArrayOne PMU is the result of the physical (i.e. electrical) limitations in the number of units which can be combined as a composite PMU

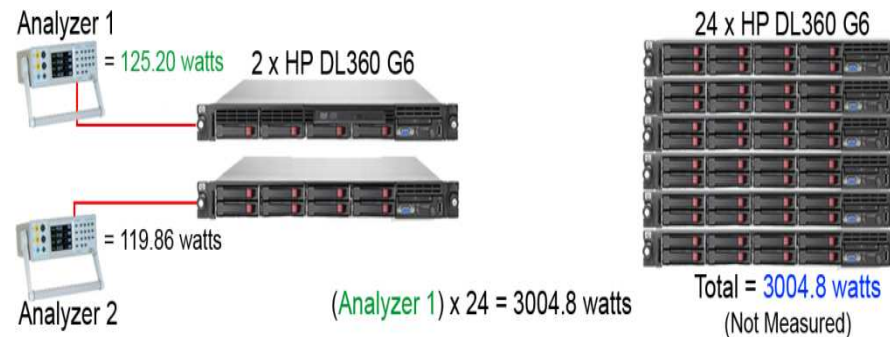


# PMU SUBSTITUTION

## STAGE ONE

The TPC-Energy specification, Clause 3.6 provides a methodology for calculating energy for PMU's which are not measured or substituted.

- At least two equivalent PMUs must be included in the measured configuration REC
- The Auditor selects two PMUs from the measured configuration to be measured for the extrapolation calculation.
- The measured PMU's energy must be less than 10% variance to be considered equivalent.
- The energy consumption value used for each of the unmeasured PMUs is the value of the highest reading of the measured PMUs
- The total energy consumed for the Priced Application servers = the measured PMU's + the energy calculated unmeasured PMUs



$$(24 \times 125.20 \text{ watts}) + 125.20 \text{ watts} + 119.86 \text{ watts} = 3249.86 \text{ watts}$$



# POWER ANALYZER CONFIGURATION

## STAGE ONE

### 1st Set Power Analyzer Power Range

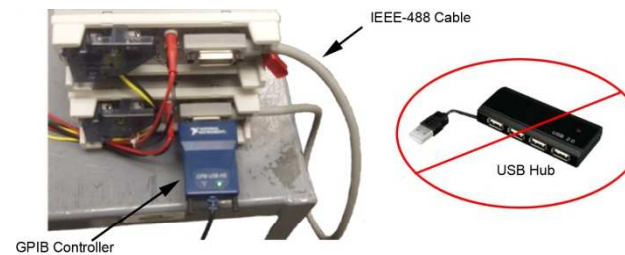
$P_{mg} = \text{PowerRange} = \text{VoltageRange} \times \text{CurrentRange}$

$V_{mg} = \text{VoltageRange} = 300 \text{ volts}$

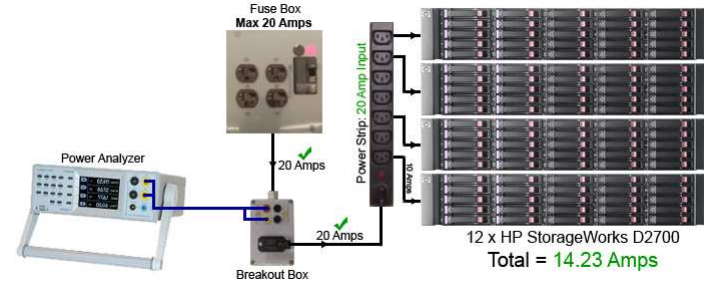
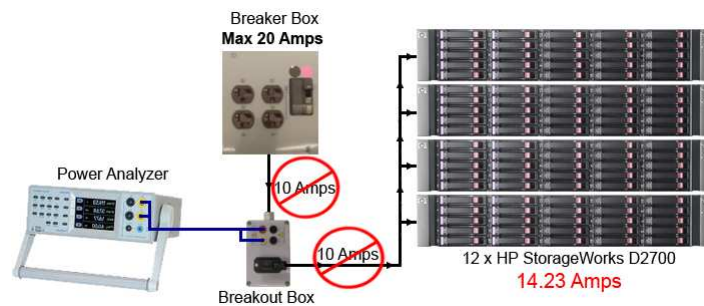
$I_{mg} = \text{CurrentRange} = 20 \text{ Amperes}$

$P_{mg} = 300 \text{ volts} \times 20 \text{ Amperes} = 6000 \text{ watts}$

### 2nd Connect Power Analyzer to Controller



### 3rd Connect the Benchmark Components

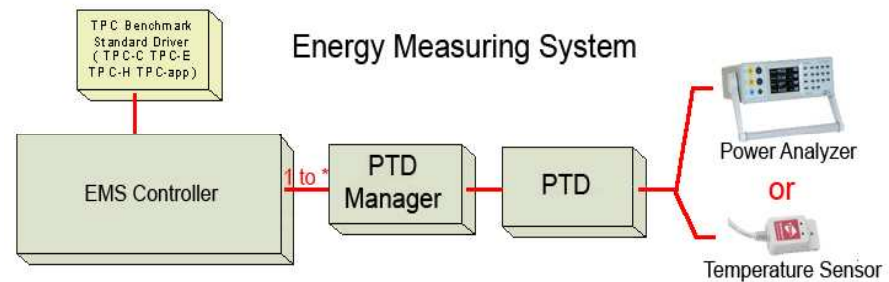


# ENERGY MEASURING SYSTEM CONFIGURATION

## STAGE ONE

The TPC-Energy Clause 4.1, defines the Energy Measuring System (EMS). It is the TPC provided software package designed to facilitate the implementation of TPC-Energy measurements. It consists of 3 software modules

- Energy Measuring System Controller
  - orchestrates the various components involved in TPC-Energy measurements
- Power Temperature Daemon Manager
  - synchronize, format, log, and forward power or temperature data received from the PTD to the EMSC
- Power Temperature Daemon
  - communicates directly to the Power Analyzer or Temperature Probe to obtain the readings



# STAGE TWO

## Execution & Validation



# TPC-ENERGY

## EXECUTION & VALIDATION

- The Validation Run
- Report Generator
- Power Analyzer Calculations



# THE VALIDATION RUN

## STAGE TWO

The Validation run typically involves auditor verification which of course ensures the run is compliant and reportable. There are several hardware and software verification criteria, below is an example of one of the validation checks.

Power Analyzer



Auditors ensure the values provided by the Power Analyzer and PTDM are identical and that the PTDM names and values seen by the EMSC are correct.

```
emsc - emsc.exe

start data now
Command> ptdm2: collecting data
ptdm1: collecting data
show ptdm
PTDM Connections (Maximum PTDMs=64)
-----+-----+-----+-----+-----+-----+
| # | Con ID | PTDM Name | PTD Host | PTD Port | PTD LogName |
-----+-----+-----+-----+-----+-----+
000: | 0      | ptdm2     | localhost | 8889      | 013.ptdm2   |
001: | 1      | ptdm1     | localhost | 8888      | 013.ptdm1   |
-----+-----+-----+-----+-----+-----+
Command>
```

```
ptdm1

<DEVICE> sample #1: 'Time_08-24-2010 10:49:16.219,Watts,20.420000,Volts,120.000000,Amps,0.170167,PF,1.000000'
<DEVICE> Last 1 sample
Time_08-24-2010 10:49:17.219,Watts,20.430000,Volts,120.000000,Amps,0.170250,PF,1.000000
<DEVICE> 1 sample lines to process
<DEVICE> sample #1: 'Time_08-24-2010 10:49:17.219,Watts,20.430000,Volts,120.000000,Amps,0.170250,PF,1.000000'
<DEVICE> Last 1 sample
Time_08-24-2010 10:49:18.219,Watts,20.440000,Volts,120.000000,Amps,0.170333,PF,1.000000
<DEVICE> 1 sample lines to process
<DEVICE> sample #1: 'Time_08-24-2010 10:49:18.219,Watts,20.440000,Volts,120.000000,Amps,0.170333,PF,1.000000'
<DEVICE> Last 1 sample
Time_08-24-2010 10:49:19.219,Watts,20.450000,Volts,120.000000,Amps,0.170417,PF,1.000000
<DEVICE> 1 sample lines to process
<DEVICE> sample #1: 'Time_08-24-2010 10:49:19.219,Watts,20.450000,Volts,120.000000,Amps,0.170417,PF,1.000000'
<DEVICE> Last 1 sample
Time_08-24-2010 10:49:20.219,Watts,20.460000,Volts,120.000000,Amps,0.170500,PF,1.000000
<DEVICE> 1 sample lines to process
<DEVICE> sample #1: 'Time_08-24-2010 10:49:20.219,Watts,20.460000,Volts,120.000000,Amps,0.170500,PF,1.000000'
```



# REPORT GENERATOR

## STAGE TWO

The Energy Measuring System's Report Generator (rgen) is a binary executable that produces standardized reports derived from the configuration and measurement data extracted from the XML logs recorded by the PTDM.

- The "Total Energy" is one of the more important values. It's used in the Power Analyzer Accuracy Calculations

```
+-----+
+
+ Starting Rec Time: 2010-06-16T13:59:09.000
+
+ Ending Rec Time: 2010-06-16T14:09:09.000
+
+ Maximum Sample: 1.000 Seconds
+
+ Maximum Jitter: 0.000 Seconds
+
+ Records Processed: 601 out of 32658
+
+ Sample Rate: 1000 milliSeconds
+
+ Time Sync Delta: 0.000 Seconds
+
+ Total Energy : 413859.9 Watt-Seconds
+-----+
```

- The minimum temperature is also very

```
+-----+
+
+ Average Minimum Peak
+ -----
+ Temperature: 20.56 20.41 20.88
+
+ Relitive Humidity: 42.35 41.00 43.00 +
+-----+
```



