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## NAME

```
x86_energy_perf_policy - Manage Energy vs. Performance Policy via x86 Model Specific Registers
```

## SYNOPSIS

```
x86_energy_perf_policy [ options ] [ scope ] [field value]
scope: --cpu cpu-list | --pkg pkg-list
cpu-list, pkg-list: # | #,# | #-# | all
field: --all | --epb | --hwp-epb | --hwp-min | --hwp-max | --hwp-desired
other: (--force | --hwp-enable | --turbo-enable) value
value: # | default | performance | balance-performance | balance-power | power
```

## DESCRIPTION

**x86\_energy\_perf\_policy** displays and updates energy-performance policy settings specific to Intel Architecture Processors. Settings are accessed via Model Specific Register (MSR) updates, no matter if the Linux cpufreq sub-system is enabled or not.

Policy in MSR\_IA32\_ENERGY\_PERF\_BIAS (EPB) may affect a wide range of hardware decisions, such as how aggressively the hardware enters and exits CPU idle states (C-states) and Processor Performance States (P-states). This policy hint does not replace explicit OS C-state and P-state selection. Rather, it tells the hardware how aggressively to implement those selections. Further, it allows the OS to influence energy/performance trade-offs where there is no software interface, such as in the opportunistic "turbo-mode" P-state range. Note that MSR\_IA32\_ENERGY\_PERF\_BIAS is defined per CPU, but some implementations share a single MSR among all CPUs in each processor package. On those systems, a write to EPB on one processor will be visible, and will have an effect, on all CPUs in the same processor package.

Hardware P-States (HWP) are effectively an expansion of hardware P-state control from the opportunistic turbo-mode P-state range to include the entire range of available P-states. On Broadwell Xeon, the initial HWP implementation, EPB influenced HWP. That influence was removed in subsequent generations, where it was moved to the Energy\_Performance\_Preference (EPP) field in a pair of dedicated MSRs -- MSR\_IA32\_HWP\_REQUEST and MSR\_IA32\_HWP\_REQUEST\_PKG.

EPP is the most commonly managed knob in HWP mode, but MSR\_IA32\_HWP\_REQUEST also allows the user to specify minimum-frequency for Quality-of-Service, and maximum-frequency for power-capping. MSR\_IA32\_HWP\_REQUEST is defined per-CPU.

MSR\_IA32\_HWP\_REQUEST\_PKG has the same capability as MSR\_IA32\_HWP\_REQUEST, but it can simultaneously set the default policy for all CPUs within a package. A bit in per-CPU MSR\_IA32\_HWP\_REQUEST indicates whether it is over-ruled-by or exempt-from MSR\_IA32\_HWP\_REQUEST\_PKG.

MSR\_HWP\_CAPABILITIES shows the default values for the fields in MSR\_IA32\_HWP\_REQUEST. It is displayed when no values are being written.

### SCOPE OPTIONS

**-c, --cpu** Operate on the MSR\_IA32\_HWP\_REQUEST for each CPU in a CPU-list. The CPU-list may be comma-separated CPU numbers, with dash for range or the string "all". Eg. '--cpu 1,4,6-8' or '--cpu all'. When --cpu is used, --hwp-use-pkg is available, which specifies whether the per-cpu MSR\_IA32\_HWP\_REQUEST should be over-ruled by MSR\_IA32\_HWP\_REQUEST\_PKG (1), or exempt from MSR\_IA32\_HWP\_REQUEST\_PKG (0).

**-p, --pkg** Operate on the MSR\_IA32\_HWP\_REQUEST\_PKG for each package in the package-list. The list is a string of individual package numbers separated by commas, and or ranges of package numbers separated by a dash, or the string "all". For example '--pkg 1,3' or '--pkg all'

### VALUE OPTIONS

**normal** | **default** Set a policy with a normal balance between performance and energy efficiency. The processor will tolerate minor performance compromise for potentially significant energy savings. This is a reasonable default for most desktops and servers. "default" is a synonym for "normal".

**performance** Set a policy for maximum performance, accepting no performance sacrifice for the benefit of energy efficiency.

**balance-performance** Set a policy with a high priority on performance, but allowing some performance loss to benefit energy efficiency.

**balance-power** Set a policy where the performance and power are balanced. This is the default.

**power** Set a policy where the processor can accept a measurable performance impact to maximize energy efficiency.

The following table shows the mapping from the value strings above to actual MSR values. This mapping is defined in the Linux-kernel header, msr-index.h.

VALUE STRING	EPB	EPP
performance	0	0
balance-performance	4	128
normal, default	6	128
balance-power	8	192
power	15	255

For MSR\_IA32\_HWP\_REQUEST performance fields (--hwp-min, --hwp-max, --hwp-desired), the value option is in units of 100 MHz, Eg. 12 signifies 1200 MHz.

### FIELD OPTIONS

**-a, --all value-string** Sets all EPB and EPP and HWP limit fields to the value associated with the value-string. In addition, enables turbo-mode and HWP-mode, if they were previous disabled. Thus "--all normal" will set a system without cpufreq into a well known configuration.

**-B, --epb** set EPB per-core or per-package. See value strings in the table above.

**-d, --debug** debug increases verbosity. By default x86\_energy\_perf\_policy is silent for updates, and verbose for read-only mode.

**-P, --hwp-epb** set HWP.EPP per-core or per-package. See value strings in the table above.

**-m, --hwp-min** request HWP to not go below the specified core/bus ratio. The "default" is the value found in IA32\_HWP\_CAPABILITIES.min.

**-M, --hwp-max** request HWP not exceed a the specified core/bus ratio. The "default" is the value found in IA32\_HWP\_CAPABILITIES.max.

**-D, --hwp-desired** request HWP 'desired' frequency. The "normal" setting is 0, which corresponds to 'full autonomous' HWP control. Non-zero performance values request a specific performance level on this processor, specified in multiples of 100 MHz.

**-w, --hwp-window** specify integer number of microsec in the sliding window that HWP uses to maintain average frequency. This parameter is meaningful only when the "desired" field above is non-zero. Default is 0, allowing the HW to choose.

## OTHER OPTIONS

**-f, --force** writes the specified values without bounds checking.

**-U, --hwp-use-pkg** (0 | 1), when used in conjunction with --cpu, indicates whether the per-CPU MSR\_IA32\_HWP\_REQUEST should be overruled (1) or exempt (0) from per-Package MSR\_IA32\_HWP\_REQUEST\_PKG settings. The default is exempt.

**-H, --hwp-enable** enable Hardware-P-state (HWP) mode. Once enabled, system RESET is required to disable HWP mode.

**-t, --turbo-enable** enable (1) or disable (0) turbo mode.

**-v, --version** print version and exit.

If no request to change policy is made, the default behavior is to read and display the current system state, including the default capabilities.

## WARNING

This utility writes directly to Model Specific Registers. There is no locking or coordination should this utility be used to modify HWP limit fields at the same time that intel\_pstate's sysfs attributes access the same MSRs.

Note that --hwp-desired and --hwp-window are considered experimental. Future versions of Linux reserve the right to access these fields internally -- potentially conflicting with user-space access.

## EXAMPLE

```
# sudo x86_energy_perf_policy
cpu0: EPB 6
cpu0: HWP_REQ: min 6 max 35 des 0 epp 128 window 0x0 (0*10^0us) use_pkg 0
cpu0: HWP_CAP: low 1 eff 8 guar 27 high 35
cpu1: EPB 6
cpu1: HWP_REQ: min 6 max 35 des 0 epp 128 window 0x0 (0*10^0us) use_pkg 0
cpu1: HWP_CAP: low 1 eff 8 guar 27 high 35
cpu2: EPB 6
cpu2: HWP_REQ: min 6 max 35 des 0 epp 128 window 0x0 (0*10^0us) use_pkg 0
cpu2: HWP_CAP: low 1 eff 8 guar 27 high 35
cpu3: EPB 6
cpu3: HWP_REQ: min 6 max 35 des 0 epp 128 window 0x0 (0*10^0us) use_pkg 0
cpu3: HWP_CAP: low 1 eff 8 guar 27 high 35
```

## NOTES

**x86\_energy\_perf\_policy** runs only as root.

## FILES

[/dev/cpu/\\*/msr](#)

## SEE ALSO

[msr\(4\)](#)  
Intel(R) 64 and IA-32 Architectures Software Developer's Manual

## AUTHORS

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Powered by the [Ubuntu Manpage Repository](#), file bugs in [Launchpad](#)

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