

CLAIMS

What is claimed is:

- 5 1. A method of assessing energy efficiency of a High-performance computing (HPC) system, comprising:
 - selecting a plurality of HPC workloads to run on a system under test (SUT) with one or more power constraints, wherein the SUT includes a plurality of HPC nodes in the HPC system;
 - executing the plurality of HPC workloads on the SUT;
 - 10 generating a benchmark metric for the SUT based on a baseline configuration for each selected HPC workload and a plurality of measured performance per power values for each executed workload at each selected power constraint;
 - normalizing one or more energy efficiency scores for each selected HPC workload by dividing the measured performance per power values for each of the one or more selected power
 - 15 constraints by a calculated baseline performance per power value for the respective HPC workload;
 - selecting an optimal operating point for each selected workload, wherein the operating point is determined based on the measured performance per power values and the one or more power constraints;
 - 20 generating a power limit for each selected workload based on the one or more executed power constraints; and
 - calculating a workload efficiency for the SUT for each selected HPC workload based on the one or more normalized energy efficiency scores.
- 25 2. The method of claim 1, wherein the baseline configuration includes identifying a baseline performance and a baseline power for each selected HPC workload, and wherein assessing energy efficiency is based on at least one of a performance per allocated power unit and a performance per measured power unit.
- 30 3. The method of claim 2, further comprising calculating a baseline performance per power value for each selected HPC workload based on the baseline performance and the baseline power for the respective HPC workload.
4. The method of claim 1, further comprising determining a power level efficiency for the
- 35 SUT for each selected HPC workload at a defined power level.

5. The method of claim 1, wherein generating the benchmark metric includes using at least one of a geometric mean, an arithmetic mean, and an area under a power curve, and is based on at least one of the measured performance per power values and a normalized performance per power values.

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6. The method of claim 1, wherein determining the baseline configuration includes defining a relative power of the HPC system or an absolute power of the HPC system.

7. The method of claim 1, further comprising defining a threshold value for the plurality of measured performance per power values.

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8. The method of claim 1, wherein selecting one or more power constraints includes an unconstrained power level and one or more constrained power levels.

9. A computer readable medium having stored thereon sequences of instruction which are executable by a system, and which, when executed by the system, cause the system to perform a method, comprising:

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selecting a plurality of HPC workloads to run on a system under test (SUT) with one or more power constraints, wherein the SUT includes a plurality of HPC nodes in a HPC system;

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executing the plurality of HPC workloads on the SUT;

generating a benchmark metric for the SUT based on a baseline configuration for each selected HPC workload and a plurality of measured performance per power values for each executed workload at each selected power constraint;

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normalizing one or more energy efficiency scores for each selected HPC workload by dividing the measured performance per power values for each of the one or more selected power constraints by a calculated baseline performance per power value for the respective HPC workload;

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selecting an optimal operating point for each selected workload, wherein the operating point is determined based on the measured performance per power values and the one or more power constraints;

generating a power limit for each selected workload based on the one or more executed power constraints; and

calculating a workload efficiency for the SUT for each selected HPC workload based on the one or more normalized energy efficiency scores.

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10. The computer readable medium of claim 9, wherein the baseline configuration includes identifying a baseline performance and a baseline power for each selected HPC workload, and wherein assessing energy efficiency is based on at least one of a performance per allocated power unit and a performance per measured power unit.

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11. The computer readable medium of claim 10, further comprising calculating a baseline performance per power unit for each selected HPC workload based on the baseline performance and the baseline power for the respective HPC workload.

10 12. The computer readable medium of claim 9, further comprising determining a power level efficiency for the SUT for each selected HPC workload at a defined power level.

13. The computer readable medium of claim 9, wherein generating the benchmark metric includes using at least one of a geometric mean, an arithmetic mean, and an area under a power
15 curve, and is based on at least one of the measured performance per power values and a normalized performance per power values.

14. The computer readable medium of claim 9, wherein determining the baseline configuration includes defining a relative power of the HPC system or an absolute power of the
20 HPC system.

15. The computer readable medium of claim 9, further comprising defining a threshold value for the plurality of measured performance per power values.

25 16. The computer readable medium of claim 9, wherein selecting one or more power constraints includes an unconstrained power level and one or more constrained power levels.

17. A system for assessing energy efficiency of a High-performance computing (HPC) system, comprising:

30 a HPC energy efficiency benchmark controller to select a plurality of HPC workloads to run on a system under test (SUT) with one or more power constraints, wherein the SUT includes a plurality of HPC nodes in the HPC system;

a controller node to execute the plurality of HPC workloads on the SUT; and

the HPC energy efficiency benchmark controller to generate a benchmark metric for the

35 SUT based on a baseline configuration for each selected HPC workload and a plurality of

measured performance per power values for each executed workload at each selected power constraint,

wherein the HPC energy efficiency benchmark controller normalizes one or more energy efficiency scores for each selected HPC workload by dividing the measured performance per

- 5 power values for each of the one or more selected power constraints by a calculated baseline performance per power value for the respective HPC workload, selects an optimal operating point for each selected workload, wherein the operating point is determined based on the measured performance per power values and the one or more power constraints, generates a power limit for each selected workload based on the one or more executed power constraints,
- 10 calculates a workload efficiency for the SUT for each selected HPC workload based on the one or more normalized energy efficiency scores, and determines a power level efficiency for the SUT for each selected HPC workload at a defined power level.

18. The system of claim 17, wherein the HPC energy efficiency benchmark controller
- 15 identifies a baseline performance and a baseline power for each selected HPC workload, selects the one or more power constraints from an unconstrained power level and one or more constrained power levels, and wherein assessing energy efficiency is based on at least one of a performance per allocated power unit and a performance per measured power unit.

- 20 19. The system of claim 18, wherein the HPC energy efficiency benchmark controller calculates a baseline performance per power unit for each selected HPC workload based on the baseline performance and the baseline power for the respective HPC workload.

20. The system of claim 17, wherein the HPC energy efficiency benchmark controller
- 25 generates the benchmark metric based on at least one of the measured performance per power values and a normalized performance per power values, and includes using at least one of a geometric mean, an arithmetic mean, and an area under a power curve.

21. The system of claim 17, wherein the HPC energy efficiency benchmark controller defines
- 30 a relative power of the HPC system or an absolute power of the HPC system.

22. The system of claim 17, wherein the HPC energy efficiency benchmark controller defines a threshold value for the plurality of measured performance per power values.