

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GOOGLE LLC

Petitioner

v.

ECOFACOR, INC.

(record) Patent Owner

Patent No. 11,835,394

DECLARATION OF RAJENDRA SHAH

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I. ENGAGEMENT AND COMPENSATION

1. My name is Rajendra Shah. (Ex. 1003). I have been retained by Google LLC for the purpose of providing my opinion with respect to the unpatentability of U.S. Pat. No. 11,835,394 (“the ’394 Patent”). I am being compensated for my time in preparing this declaration at my standard hourly rate, and my compensation is not dependent upon my opinions or the outcome of the proceedings. My curriculum vitae is attached as Ex. 1003.

II. QUALIFICATIONS

2. I am currently the Principal at AnalyzRS LLC, a company providing, among other things, consulting services for the HVAC industry. I have been employed in this position since 2016.

3. I consider myself to have significant knowledge and experience in Heating, Ventilating and Air Conditioning (“HVAC”) systems, with particular knowledge relating to associated technology integration, control algorithms, modeling and simulation, and data analytics. I have significant knowledge and experience relating to the optimization of the operational efficiency of HVAC systems. My current Curriculum Vitae is attached as Exhibit 1003, and summarizes my qualifications.

4. Prior to my work for AnalyzRS LLC, I was employed at United

Technologies Carrier Corporation in Indianapolis, Indiana from 1991 to 2016. During my career at Carrier, my work focused on the design and development of HVAC systems and associated technologies. From 1991 to 2000, I was employed as a Senior Program Manager for Advanced Systems at Carrier. While in that position, I had responsibility for the launch of new product categories, including two stage air conditioners and heat pumps, variable speed fan coils, digital thermostats, multi zone controls, expandable filters, and fresh air ventilators.

5. From 2000 to 2008 I was employed as an Engineering Manager for Systems Development. In that role I designed and managed the design of premium air conditioners, heat pumps, indoor fan coils, advanced thermostats, multi-zone controls and indoor air quality products. In particular, my team developed Carrier's Infinity® HVAC system, which was originally launched in 2004, and which went on to be a highly successful product.

6. From 2008 to 2016 I held the title of Engineering Fellow, Systems and Controls. I was one of the first eight Fellows selected to what was Carrier's top engineering position out of thousands of engineers worldwide. While in this position, I worked to develop Carrier's Infinity® Touch Control system with internet connectivity, which was first launched in 2012. This product received the Dealer Design Gold award from industry magazine ACHR News in 2013 and has continued to be a top-selling product for Carrier.

7. Beginning in 1984, I was employed as Project Manager for Electronically Commutated (Brushless DC) Motors at General Electric (GE) Motors. While employed in this role, I developed and launched GE's new line of brushless DC variable speed motors targeted at residential heating and air conditioning applications.

8. Beginning in 1977, I was employed by United Technologies Electronic Controls as a Project Engineer for Control Design. In this position, I designed high volume electronic controls, including electronic circuit design and microprocessor software, for appliances and heating and air conditioning systems.

9. I am a named inventor on at least 50 patents, with applications still pending. My patents primarily relate to the field of HVAC technology.

10. I hold a Bachelor's degree in Electrical Engineering from the Indian Institute of Technology, Bombay, India, which I obtained in 1975. I also obtained a Master's degree in Electrical Engineering, Ohio State University, Columbus, Ohio in 1977 and a Master's degree in Business Administration from the University of St Francis, Fort Wayne, Indiana in 1983.

III. SUMMARY OF OPINIONS

11. In my opinion, the challenged claims are rendered obvious by the cited prior art, as summarized below:

Ground 1: Claims 1-3, 5, 10-12, and 14 are obvious over Hildebrand in view

of Shah.

Ground 2: Claims 1-5 and 10-14 are obvious over Hildebrand in view of Shah, further in view of Rosen.

Ground 3: Claims 1-3, 5-6, 10-12, and 14-15 are obvious over Hildebrand in view of Shah, further in view of Van Ostrand.

Ground 4: Claims 1-6 and 10-15 are obvious over Hildebrand, Shah, Rosen and Van Ostrand.

Ground 5: Claims 7-9 and 16-18 are obvious over Hildebrand, Shah, Rosen and Van Ostrand, further in view of McNulty.

IV. MATERIALS REVIEWED

12. In forming my opinions, I have relied on my knowledge of the field and my experience, and have specifically reviewed the following exhibits:

Exhibit No.	Description
1001	U.S. Patent No. 11,835,394 (“ the ’394 patent ”).
1004	U.S. Patent No. 5,729,474 (“ Hildebrand ”).
1005	U.S. Pat. App. Pub. 2005/0171645 A1 (“ Oswald ”).
1006	U.S. Patent No. 5,555,927 (“ Shah ”).
1007	U.S. Pat. App. Pub. 2005/0159846 A1 (“ Van Ostrand ”).
1008	U.S. Patent No. 6,216,956 (“ Ehlers ”).
1009	U.S. Patent No. 6,789,739 (“ Rosen ”).

1010	Public Copy of Initial Determination in <i>Smart HVAC Systems, and Components Thereof</i> 337-TA-1185 (ITC).
1011	File History of U.S. App. Ser. No. 18/104,767 (“ the ’767 Application ”).
1012	U.S. Pat. App. Pub. US 2004/0117330 A1 (“ Ehlers ’330 ”).
1013	Chart of Prior Determinations Involving Related Patents.
1014	List of Prior Related Proceedings.
1015	U.S. Patent No. 8,423,322 (“ the ’322 patent ”).
1016	U.S. Patent No. 8,019,567 (“ the ’567 patent ”).
1017	IPR2021-01218, Paper 2 (Petition).
1018	IPR2021-01218, Paper 22 (Final Written Decision).
1019	Request for Reexamination of U.S. Patent No. 8,423,322, dated August 4, 2022 in Reexamination App. No. 90/015,086.
1020	Non-Final Action dated February 7, 2023 in Reexamination App. No. 90/015,086.
1021	Reexamination Certificate dated August 23, 2023 in Reexamination App. No. 90/015,086.
1022	U.S. Patent No. 5,934,554 (“ Charles ”).
1023	U.S. Patent No. 6,029,092 (“ Stein ”).
1024	U.S. Pat. App. Pub. US 2011/0251726 (“ McNulty ”).
1025	EcoFactor Opposition to Motion to Dismiss, <i>EcoFactor, Inc. v. Google LLC</i> , No. 4:24-cv-00175 (N.D. Cal. Apr. 23, 2024).
1026	EcoFactor Complaint, <i>EcoFactor, Inc. v. Google LLC</i> , No. 5:24-cv-00175 (N.D. Cal. Jan. 9, 2024).
1027	EcoFactor Complaint, Ex. 2 (Claim Chart), <i>EcoFactor, Inc. v. Google LLC</i> , No. 5:24-cv-00175 (N.D. Cal. Jan. 9, 2024).

1028	Public Copy of Commission Opinion in <i>Smart HVAC Systems, and Components Thereof</i> 337-TA-1185 (ITC).
1029	File History of U.S. App. Ser. No. 17/700,409.
1030	File History of U.S. App. Ser. No. 16/806,779.
1031	File History of U.S. App. Ser. No. 15/905,251.
1032	Case Schedule in <i>EcoFactor, Inc. v. Google LLC</i> , Case No. 4:24-cv-00175 (N.D. Cal. June 25, 2024).
1033	Transcript of July 8, 2022 deposition of Dr. John Palmer in IPR2021-01218.
1034	Claim Construction Order in Certain <i>Smart Thermostat Systems, Smart HVAC Systems, Smart HVAC Control Systems and Components Thereof</i> 337-TA-1258 (ITC).
1035	Public Copy of Commission Opinion in Certain <i>Smart Thermostat Systems, Smart HVAC Systems, Smart HVAC Control Systems and Components Thereof</i> 337-TA-1258 (ITC).
1036	<i>Google LLC v. EcoFactor, Inc.</i> , No. 23-1757 (Fed. Cir. July 15, 2024)
1037	Joint Claim Construction Statement in <i>EcoFactor, Inc. v. Google LLC</i> , Case No. 4:24-cv-00175 (N.D. Cal. October 22, 2024).
1038	PCT Application Publication WO2007/128783 A1

V. UNDERSTANDING OF THE RELEVANT LAW

13. I have the following understanding of the applicable law:

A. Anticipation

14. I understand that a claim in an issued patent can be unpatentable if it is anticipated. I understand that “anticipation” means that there is a single prior art

reference that discloses every element of the claim, arranged in the way required by the claim.

15. I understand that an anticipating prior art reference must disclose each of the claim elements expressly or inherently. I understand that “inherent” disclosure means that the claim element, although not expressly described by the prior art reference, must necessarily be present based on the disclosure. I understand that a mere probability that the element is present is not sufficient to qualify as “inherent disclosure.”

B. Obviousness

16. I understand that a claim in an issued patent can be unpatentable if it is obvious. Unlike anticipation, obviousness does not require that every element of the claim be in a single prior art reference. Instead, it is possible for claim elements to be described in different prior art references, so long as there is motivation or sufficient reasoning to combine the references, and a reasonable expectation of success in achieving what is set forth in the claims.

17. I understand that a claim is unpatentable for obviousness if the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the alleged invention was made to a person having ordinary skill in the art to which said subject matter pertains.

18. I understand, therefore, that when evaluating obviousness, one must consider obviousness of the claim “as a whole”. This consideration must be from the perspective of the person of ordinary skill in the relevant art, and that such perspective must be considered as of the “time the invention was made.”

19. The level of ordinary skill in the art is discussed in ¶¶27-31 below.

20. The relevant time frame for obviousness, the “time the invention was made”, is discussed in ¶¶32-33, below.

21. I understand that in considering the obviousness of a claim, one must consider four things. These include the scope and content of the prior art, the level of ordinary skill in the art at the relevant time, the differences between the prior art and the claim, and any “secondary considerations.”

22. I understand that “secondary considerations” include real-world evidence that can tend to make a conclusion of obviousness either more probable or less probable. For example, the commercial success of a product embodying a claim of the patent could provide evidence tending to show that the claimed invention is not obvious. In order to understand the strength of the evidence, one would want to know whether the commercial success is traceable to a certain aspect of the claim not disclosed in a single prior art reference (*i.e.*, whether there is a causal “nexus” to the claim language). One would also want to know how the market reacted to disclosure of the invention, and whether commercial success might be traceable to

things other than innovation, for example the market power of the seller, an advertising campaign, or the existence of a complex system having many features beyond the claims that might be desirable to a consumer. One would also want to know how the product compared to similar products not embodying the claim. I understand that commercial success evidence should be reasonably commensurate with the scope of the claim, but that it is not necessary for a commercial product to embody the full scope of the claim.

23. Other kinds of secondary considerations are possible. For example, evidence that the relevant field had a long-established, unsolved problem or need that was later provided by the claimed invention could be indicative of non-obviousness. Evidence that others had tried, but failed to make an aspect of the claim might indicate that the art lacked the requisite skill to do so. Evidence of copying of the patent owner's products before the patent was published might also indicate that its approach to solving a particular problem was not obvious. Evidence that the art recognized the value of products embodying a claim, for example, by praising the named inventors' work, might tend to show that the claim was non-obvious.

24. I further understand that prior art references can be combined where there is an express or implied rationale to do so. Such a rationale might include an expected advantage to be obtained, or might be implied under the circumstances.

For example, a claim is likely obvious if design needs or market pressures existing in the prior art make it natural for one or more known components to be combined, where each component continues to function in the expected manner when combined (*i.e.*, when there are no unpredictable results). A claim is also likely unpatentable where it is the combination of a known base system with a known technique that can be applied to the base system without an unpredictable result. In these cases, the combination must be within the capabilities of a person of ordinary skill in the art.

25. I understand that when considering obviousness, one must not refer to teachings in the specification of the patent itself. One can, however, refer to portions of the specification admitted to being prior art, including the “BACKGROUND” section. Furthermore, a lack of discussion in the patent specification concerning how to implement a disclosed technique can support an inference that the ability to implement the technique was within the ordinary skill in the prior art.

26. I understand that claims can be found unpatentable for other reasons as well, but note that I was not asked to consider whether the challenged claims are unpatentable for lack of written description, enablement, or indefiniteness.

VI. LEVEL OF ORDINARY SKILL IN THE ART

27. In my opinion, the relevant art was that of heating, ventilation, and air conditioning (“HVAC”) control and building automation. (Ex. 1001, Abstract, 1:35-5:63).

28. In my opinion, the level of ordinary skill encompassed a person with at least a (1) Bachelor's degree in engineering, computer science, or a comparable field of study, and (2) at least five years of (i) professional experience in building energy management and controls, or (ii) relevant industry experience. In my opinion, additional relevant industry experience may compensate for lack of formal education or vice versa.

29. I believe I would meet this definition, and would have met this definition in the relevant timeframe. My testimony is offered from this perspective, even if it does not specifically refer to the perspective of a person of ordinary skill in the art in every instance.

30. I understand that with respect to a related patent, the Patent Trial and Appeal Board has previously found that the level of ordinary skill encompasses a person who "would have a bachelor's degree in engineering, computer science, or a comparable field, with 2–3 years' experience in temperature controls, embedded control systems, electronic thermostats, or HVAC controls, or similarly relevant industry experience, with relevant experience substituting for education and vice versa." (Ex. 1018, pp.9-10). I believe I would also meet this definition, and would have met this definition in the relevant timeframe.

31. In my opinion, the challenged claims are rendered obvious under either definition.

VII. RELEVANT TIMEFRAME FOR DETERMINING OBVIOUSNESS

32. I understand that obviousness must be evaluated “at the time of the invention.” From the cover pages of the ’394 patent, I can see that the first provisional application for a patent was filed in the United States on September 17, 2007.

33. For the purpose of this declaration, I will analyze obviousness in the time frame immediately prior to this date, although my testimony is usually applicable to a longer period of time before September 17, 2007. My testimony is directed to this timeframe, even if I do not always use a past tense.

VIII. TECHNICAL INTRODUCTION

A. The ’394 Patent Disclosure

34. The ’394 patent is one of a family of patents directed to controlling HVAC systems. The ’394 patent at-issue (with an earliest-possible benefit date of 2007) relates generally to controls for climate control systems, such as heating and cooling systems (“HVAC systems”). (Ex. 1001, Abstract, 1:35-5:63).

35. HVAC systems have, for decades, been controlled by thermostats. (Ex. 1001, 1:40-2:9). Thermostats are typically wall-mounted units that have an internal temperature sensor, and which allow a user to set a target temperature. The target temperature, or “setpoint,” is compared against the actual temperature, and the HVAC system switched on or off in an attempt to maintain the setpoint temperature.

36. As the ’394 patent accurately summarizes, “[a]t the most basic level, a

thermostat includes a means to allow a user to set a desired temperature, a means to sense actual temperature, and a means to signal the heating and/or cooling devices to turn on or off in order to try to change the actual temperature to equal the desired temperature.” (Ex. 1001, 1:51-56).

37. The '394 patent recognizes that programmable thermostats were in use prior to the time of invention. (Ex. 1001, 1:48-2:26). I note that one common prior art use of programmable thermostats was in “setback and recovery” schedules. Such schedules change the setpoint of a thermostat at different times of day. This can be done, for example, in order to save energy when the building is unoccupied. For example, a workplace thermostat could be programmed during the winter to have a daytime (8 AM to 5 PM) setpoint of 70 F, and an evening setpoint of 50 F (when the building is expected to be unoccupied). Allowing the building to cool down to 50 F in the evening is called “setback”, while heating the building back up to 70 F in the morning is called “recovery.”

38. Like all mechanical devices, HVAC systems may degrade in their performance over time. Detecting such degradations in performance is, broadly speaking, the purpose of the claims of the '394 patent. The claims of the '394 Patent generally involve (1) receiving temperatures from inside and outside a structure, (2) calculating a current operating profile for a climate control device, (3) evaluating whether the operational efficiency of the climate control device has decreased over

time, and (4) outputting a result of the evaluation. (Ex. 1001, claims 1, 10).

39. I note that specification of the '394 patent does not teach how to perform some functional limitations of the claims. For example, there is no disclosure concerning how to “compare[] the first [inside] temperatures and the second [outside] temperatures over time to calculate a current operating profile for the climate control device.” Nor does the specification teach how to “compare[] a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time.”

40. I note that the words “operating profile” only appear in the claims. I note that the words “operational efficiency” appear only in the Abstract and claims of the '394 patent and again in portions of the written description that are similar to certain language of the claims. (*See, e.g.*, Ex. 1001, Abstract, 1:43-44, 4:41-42, 4:64-65). However, the '394 patent discloses no specific algorithms, calculations, or equations for calculating an operating profile or an operational efficiency.

41. As set forth in detail below, in my opinion, the elements of the '394 patent's claims were obvious over the prior art. In my opinion, the claims of the '394 patent are directed to nothing more than known technologies and their obvious implementation in a climate control device.

B. Patent Family and Prosecution History of the '394 Patent

42. I am informed that the '394 Patent is yet another in a chain of patents, including U.S. Patent Nos. 8,019,567 (“’567 Patent”) and 8,423,322 (“’322 Patent”) (collectively, the “related patents”). I note that the related patents originally issued with claims that have been found unpatentable over the same prior art relied on in this declaration, by the Patent Trial and Appeal Board, the Central Reexamination Unit (“CRU”), and/or the International Trade Commission (“ITC”).¹

43. I understand that in prosecuting the application that led to the issuance of the '394 patent, Patent Owner (or “PO”) EcoFactor submitted an Information Disclosure Statement (IDS) on April 11, 2023 that did not include any of the primary references relied upon in this petition (or in the prior PTAB, ITC and *ex parte* proceedings involving the related patents). (Ex. 1011, pp.67-74). I am also informed that EcoFactor did not disclose the existence of the co-pending proceedings

¹ Prior determinations regarding the related patents are summarized in Exhibit 1013. (See Exs. 1017, 1018, 1016, 1019, 1020, 1021, 1015, 1010, pp.482-493, 1028). As detailed in that exhibit, many of the same and similar issues raised in the present proceeding have previously been resolved against EcoFactor.

involving the related patents.² Despite the Patent Trial and Appeal Board issuing a final written decision invalidating claims of the '567 patent in view of Hildebrand and Van Ostrand, and the CRU rejecting all claims of the '322 patent in view of Hildebrand, I am informed that EcoFactor never disclosed Hildebrand during prosecution of the '394 patent.

44. The '394 patent issued on December 5, 2023.

IX. CLAIM INTERPRETATION

A. BACKGROUND ON CLAIM INTERPRETATION

45. I understand that it is sometimes necessary or useful for claim terms in a patent to be further explained or interpreted (“construed”). I understand that in the present proceeding, the Board applies the same claim construction standard used by District Courts in actions involving the validity or infringement of a patent. This involves construing claim terms in accordance with the ordinary and customary meaning of such terms, as understood by one of ordinary skill in the art, in light of the claim language, the technical disclosure of the patent (*i.e.*, the specification) and

² I understand that EcoFactor has also recently emphasized the “similar[ity] [of the] limitations” in the patents, and has argued that the “same” reasoning for the '322 patent should be applied to the '394 Patent with respect to patent eligibility. (*See* Ex. 1025, pp.006, 021).

the prosecution history or “file history” of correspondence with the United States Patent and Trademark Office (USPTO) pertaining to the patent.

46. I further understand that the file history of a parent patent application can be relevant to the claim construction of claim terms appearing in patents that have descended from that parent application.

47. I understand that certain “extrinsic” evidence, such as dictionaries or other prior art, can sometimes be useful to understand the meaning of a claim term. However, I understand that where there is a conflict between any such extrinsic evidence and the patent and patent’s prosecution history, the latter control.

B. CLAIM INTERPRETATION OF THE ’394 PATENT

48. I understand that no claim construction orders have been issued for the ’394 patent. I understand that EcoFactor has not identified any claim term requiring an express construction in the accompanying litigation. (*See* Ex. 1037)(*see id.*, p.017)(EcoFactor’s proposal for “operational efficiency”).

49. In my opinion, the prior art relied on herein renders obvious the subject matter of the challenged claims under any reasonable construction, including their plain meaning.

50. I understand that in prior International Trade Commission (“ITC”) investigations addressing related patents, EcoFactor has contended in the ITC that “operational efficiency” should be construed as “energy or time to change inside

temperature by any given amount for a set of one or more indoor or outdoor conditions.” (Ex. 1010, p.32)(Ex. 1034, p.021)(arguing “operational efficiency of an HVAC system” means “energy or time required by the HVAC system to change inside temperature by any given amount for a set of one or more indoor and outdoor conditions”)(Ex. 1035, pp.49-53). Solely for the purposes of this proceeding, I apply EcoFactor’s apparent understanding of this term as set forth in more detail below. I also highlight and apply what I understand to be EcoFactor’s apparent litigation interpretations of the challenged claims in certain instances as further set forth in detail below.

51. I express no opinion regarding the correctness of EcoFactor’s apparent claim interpretations.

X. GROUND 1: CLAIMS 1-3, 5, 10-12, AND 14 ARE OBVIOUS OVER HILDEBRAND IN VIEW OF SHAH.

52. In my opinion, claims 1-3, 5, 10-12, and 14 are obvious over U.S. Pat. No. 5,729,474 (“Hildebrand”)(Ex. 1004) in view of U.S. Pat. No. 5,555,927 (“Shah”)(Ex. 1006).

53. I understand that neither Hildebrand nor Shah was of record in the application leading to the ’394 patent.

A. Effective Prior Art Dates of Hildebrand and Shah

54. **Hildebrand** is a U.S. patent that issued on March 17, 1998, and I

understand that it is thus prior art.

55. **Shah** is a U.S. patent that issued on September 17, 1996, and I understand that it is thus prior art.

B. Overview of the Combination

56. In my opinion, Hildebrand teaches or suggests all elements of independent claims 1 and 10 of the '394 patent. However, I also present my opinions regarding unpatentability in view of Shah because I understand that EcoFactor may present certain arguments regarding the claimed “operating profile” and claimed “operational efficiency” similar to positions it has taken in a prior proceedings. The independent claims of the '394 patent require a comparison of a “current operating profile” and “a stored temperature profile that represents a previous operating profile” “to evaluate whether an operational efficiency of the climate control device has decreased over time.” I understand that EcoFactor may take a narrow interpretation of this limitation, including that an operational efficiency is measured in and must have units of *time*. (*See, e.g.,* Ex. 1037, p.017). To the extent this is not already disclosed in Hildebrand, in my opinion, it would have been obvious to implement Hildebrand’s efficiency values using Shah’s thermal time constants (which have units of time), which form an operating profile and are measures of operational efficiency.

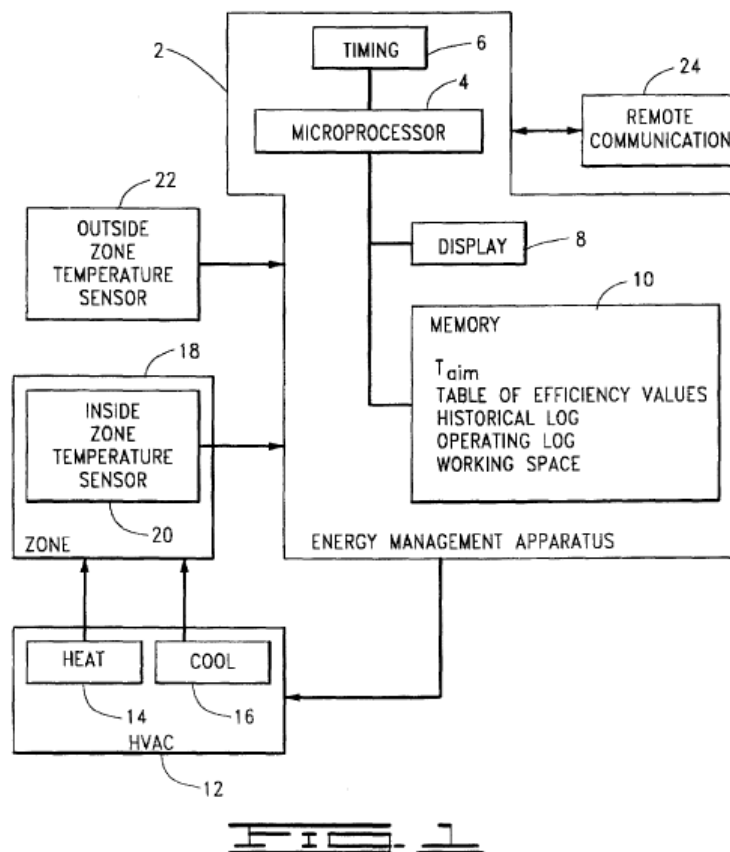
57. Furthermore, in my opinion, the extent Hildebrand does not already

disclose a database, it would have been obvious for Hildebrand's memory to be implemented to include a database.

58. In my opinion, Hildebrand and Shah further render obvious dependent claims 2-3, 5, 11-12, and 14 as discussed in detail below. Principally, as relevant to the dependent claims, to the extent that Hildebrand does not already teach or suggest the use of a programmable thermostat, in my opinion, a PHOSITA would have also been motivated to implement Hildebrand using a programmable thermostat, such as Shah's thermostat, that communicates with the climate control device and displays the result of an evaluation of efficiency of the climate control device.

1. Overview of Hildebrand.

59. Hildebrand teaches that its system "anticipat[es] potential HVAC failure". (Ex. 1004, Title). Hildebrand's overall system (as depicted below in Fig. 1) contains, among other things, an "HVAC system 12," inside temperature sensor 20, outside temperature sensor 22, microprocessor 4 to analyze data, and memory 10.



(Ex. 1004, Fig. 1, 3:32-4:34).

60. Hildebrand collects indoor and outdoor temperatures and calculates operational efficiency values (K) for the HVAC system over time. (Ex. 1004, Abstract, 6:12-8:20). Hildebrand compares the operational efficiency values (K) over time to determine whether efficiency has decreased. (Ex. 1004, Abstract, 6:12-8:20). If so, Hildebrand's system sends a signal requesting maintenance. (Ex. 1004, Abstract, 1:50-52).

2. Overview of Shah

61. Shah teaches a system having a thermostat 12 which controls a "space temperature control unit 27," which heats and cools a controlled space 10 (e.g., a

building), as depicted in Shah's Figure 1, below:

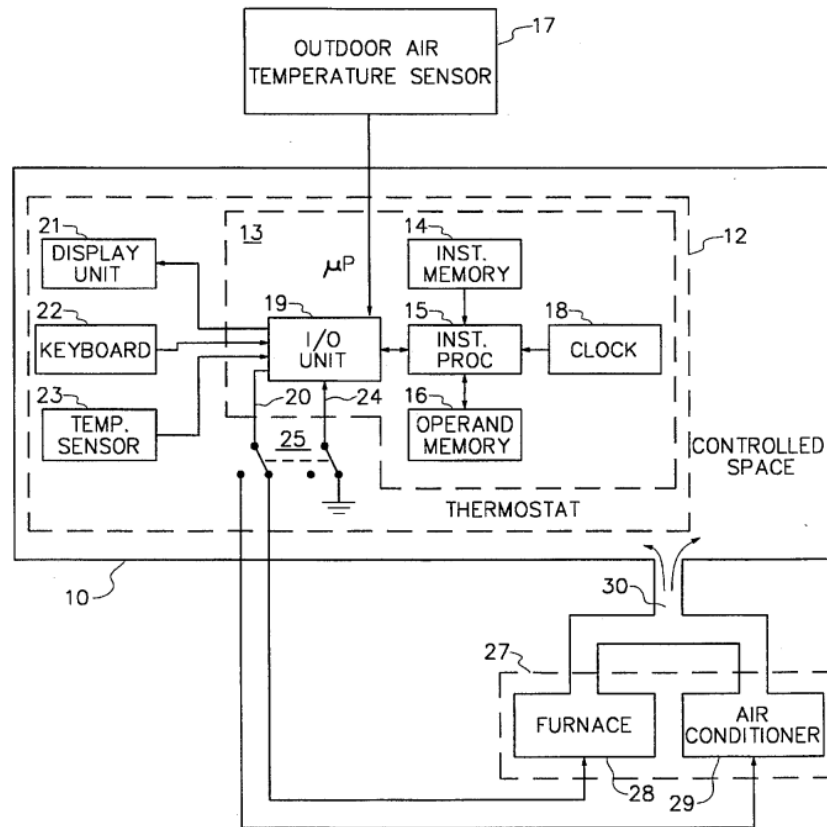


Fig. 1

(Ex. 1006, Fig. 1, 8:19-43).

62. Shah uses inside and outside temperatures to compute thermal time constants (τ), which for day N is defined as a ratio between $[T_s - T_{oa}]_N$ ("the average temperature difference between the current sensed space temperature and the outdoor air temperature during a time period when the space conditioning plant is 'ON'") and $[dT_s/dt]_N$ ("the time rate of change of the sensed space temperature during this same time period"):

$$\tau_{s,N} = \frac{[T_s - T_{oa}]_N}{[dT_s/dt]_N} \quad (5)$$

(Ex. 1006, 3:21-4:35, Eq. 5). Shah’s “thermal time constants” (τ) are operational efficiency values that have units of time. Differences in thermal time constants τ on different days are reflected with ξ , defined in Shah’s Eqs. (8) and (9). (Ex. 1006, 4:21-45). By accounting for changes in τ over time, the value for ξ “provides an ability to monitor the integrity of the thermal system” for “diagnostics purposes.” (Ex. 1006, 4:63-5:10).

C. Rationale (Motivation) Supporting Obviousness

1. Shah’s Thermal Time Constant as Operating Profile/Operational Efficiency

63. In my opinion, a PHOSITA would have been motivated to incorporate the use of Shah’s thermal time constants (τ) in Hildebrand’s system to measure and evaluate the efficiency of HVAC operating equipment and to use Hildebrand’s processor to perform efficiency calculations in view of Shah’s teachings.

64. Hildebrand calculates efficiency values K as a ratio between a time period Δt and a temperature difference, expressed as $\Delta t / |T_{\text{start}} - T_{\text{aim}}|$, where Δt is “the amount of time [] it takes for the energized HVAC system 12 to change the actual temperature in the zone 18 from the respective T_{start} to the respective T_{aim} .” (Ex.

1004, 6:26-64).³ The temperature change $T_{\text{start}} - T_{\text{aim}}$ (expressed as ΔT) occurs over the time period Δt . (*Id.*). Hildebrand's K value forms a part of an **operating profile** because it indicates how efficiently the HVAC operates over a duration of time in order to achieve a temperature change ΔT , and has unit time/temperature. As I explain below, in my opinion, this renders obvious the use of measurements in units of time.

65. To the extent the claimed **operating profile** is determined to be or reflect an **operational efficiency** that must be measured in units of energy or time (consistent with arguments I understand have been previously made by EcoFactor with respect to a related patent, Ex. 1010, p.32), in my opinion, it would have been obvious to use Shah's thermal time constant value (τ), which is an efficiency value having unit time, in Hildebrand's system.

66. Shah computes its thermal time constant (τ) for day N in Eq. 5 as a ratio of $[T_s - T_{\text{oa}}]_N$ ("the average temperature difference between the current sensed space temperature and the outdoor air temperature during a time period when the space conditioning plant is 'ON'") and $[dT_s/dt]_N$ ("the time rate of change of the sensed

³ T_{start} is the value for the inside temperature at the beginning of the time period and T_{aim} is both the setpoint and the value for the inside temperature at the end of the time period. (Ex. 1004, 5:3-4, 6:12-64, 3:60-62).

space temperature during this same time period”):

$$\tau_{s,N} = \frac{[T_s - T_{oa}]_N}{[dT_s/dt]_N} \quad (5)$$

(Ex. 1006, 3:21-4:35). Shah’s τ value therefore has units of (temperature/(temperature/time)), which is *time*, and represents a “time to change inside temperature by any given amount for a set of one or more indoor or outdoor conditions.” (See Ex. 1010, p.32).

67. Both Hildebrand and Shah use their efficiency values to evaluate whether the HVAC’s efficiency has decreased over time. Just as Hildebrand compares efficiency values (K) to “determine whether the efficiency of the HVAC system 12 has changed over time” (Ex. 1004, 7:5-17), Shah uses ξ (Eqs. 8-9) to reflect differences in its thermal time constants τ on different days and “monitor the integrity of the thermal system” for “diagnostics purposes.” (Ex. 1006, 4:21-45, 4:63-5:10).

68. Both systems also account for outside temperature. Hildebrand stores the K values in a table indexed by T_{out} and compares efficiencies for the same T_{out} . (Ex. 1004, 6:65-7:62). Shah also accounts for outside temperature, but does so directly in its calculation of the numerator for τ , by subtracting the outside temperature from the indoor temperature. By accounting for T_{out} directly in its efficiency calculation, Shah can compare efficiencies between “any two” different

days (*see* Ex. 1006, 4:21-26), rather than being limited (like Hildebrand) to comparisons between time periods with the “same” outside temperature T_{out} .

69. In my opinion, a PHOSITA would have therefore been motivated to modify Hildebrand’s system to implement Shah’s τ values indexed by day in addition to or instead of Hildebrand’s efficiency table of K values indexed by T_{out} . Such an implementation would have been beneficial, as it would have provided predictive diagnostics which are valid for a greater range of times and conditions. For example, Shah’s τ values can be used to directly perform comparisons between any two different days (irrespective of the weather conditions).

70. Hildebrand’s microprocessor performs the calculations regarding rates of change and efficiency values and in my opinion, it would have been obvious to use the same processor to also perform efficiency calculations according to Shah’s teachings as this would have involved nothing more than standard processing functionality.

71. Additionally, in my opinion, using Shah’s τ values in Hildebrand’s system would have involved using a known technique to improve Hildebrand in a known way, without unpredictable results.

2. Database

72. To the extent that Hildebrand does not already teach or suggest the use of a database, in my opinion, a PHOSITA would have been motivated to implement

Hildebrand with a database to store temperatures and operating profiles over time.

73. In my opinion, a PHOSITA would have been motivated to use a database in order to facilitate storage and organization of data, including Hildebrand's efficiency values indexed by outside temperature. Databases were a common and well-known method of data storage in that timeframe. Databases were widely used to store electronic information in an organized fashion and would have been used predictably for that purpose with no unexpected results. (Exs. 1005; 1022; 1023). I note that a number of databases were available in the relevant timeframe and were in use for climate control devices. (Ex. 1005, ¶¶0056-0059, Ex. 1023, Abstract, Fig. 2, 9:26-50, Ex. 1022, 1:64-66).

3. Shah's Thermostat

74. To the extent that Hildebrand does not already teach or suggest the use of a programmable thermostat, in my opinion, a PHOSITA would have also been motivated to implement Hildebrand using a programmable thermostat, such as Shah's thermostat, that communicates with the climate control device and displays the result of an evaluation of efficiency of the climate control device (*see* dependent claims 2/11, 5/14).

75. Hildebrand already uses a sensor to measure indoor temperature (Ex. 1004, 4:11-15, Fig. 1), and further discloses the use of thermostats and microprocessor-based HVAC controllers, which a PHOSITA would have

understood to be a programmable thermostat. (Ex. 1004, 1:10-17). Moreover, as the '394 patent recognizes, programmable thermostats were already “prevalent” at the time of the alleged invention. (Ex. 1001, 1:60-65).

76. In my opinion, a PHOSITA would have been motivated to 1) implement Hildebrand’s energy management apparatus to include a programmable thermostat, or 2) to implement Hildebrand’s inside temperature sensor to be part of a programmable thermostat. Programmable thermostats were commonly used to communicate with HVAC equipment in the relevant timeframe, provide indoor temperature data in a convenient and cost effective manner, and had displays for providing information relating to the HVAC and temperatures to the user. (Ex. 1009, 1:18-55)(Ex. 1006, 1:59-67). Moreover, a PHOSITA would have recognized that, when implementing Hildebrand’s system in a building with a pre-existing programmable thermostat, it would have been desirable to keep the building’s existing thermostat in place for cost reduction and user convenience. (*See* Ex. 1004, 4:45-52). In addition, for buildings with multiple zones (which can be controlled by multiple thermostats), as contemplated by Hildebrand (Ex. 1004, 4:46-52, 4:55-5:17, 5:29-39), it would have been obvious to implement user setpoint and inside temperature data in a programmable thermostat, as taught by Shah, in order to allow a user to view the inside temperature and view and change the setpoint. The ability to view inside temperature and change a setpoint represent standard functionality for

a programmable thermostat. Additionally, this would allow a user to view the inside temperature and modify the setpoint from any control location within the building.

77. Additional explanation of the rationale (motivation) supporting obviousness will be provided in the Claim Mapping section below, under each element as appropriate.

D. Reasonable Expectation of Success

78. In my opinion, a PHOSITA in the relevant timeframe would have had a reasonable expectation of success in implementing the combination (as described with particularity below in the claim mapping section).

79. **(Time Constant as Operating Profile/Operational Efficiency):** A PHOSITA would have had a reasonable expectation of success in incorporating Shah's use of τ values into Hildebrand's system. In my opinion, the art was relatively predictable in the relevant timeframe (2007). Shah and Hildebrand, moreover, are software-based systems that use well-known components, and were thus predictable in nature. Additionally, using Shah's τ values in Hildebrand's system would have involved using a known technique to improve Hildebrand in a known way, without unpredictable results, and would thus also have been obvious.

80. **(Database):** In my opinion, to the extent it is not already disclosed, a PHOSITA would have had a reasonable expectation of success implementing a database in Hildebrand's system because the modification is merely combining prior

art elements according to known methods to yield predictable results (*i.e.*, using a database to save and index data over time). Additionally, using a database to organize and store data was a known technique that would have been substituted for the technique of using memory without a database, with no unexpected results.

81. **(Programmable Thermostat):** In my opinion, a PHOSITA would have had a reasonable expectation of success implementing Hildebrand with a programmable thermostat that displays an evaluation result (per certain dependent claims) because the implementation is merely combining prior art elements according to known methods to yield predictable results (*i.e.*, using a thermostat that provides the inside temperature data and displays evaluations, to save on cost)(*see, e.g.*, Ex. 1009, 3:3-30)(Ex. 1012, ¶¶0017, 0149, 0238). A PHOSITA would have found it obvious to implement Hildebrand to include such a thermostat, and it would have been well within ordinary skill made standard modifications to a programmable thermostat to communicate and to display information regarding the functioning of the system. (*see also* Ex. 1004, 7:63-8:11, 2:7-10, 3:46-49, 4:22-34). Additionally, programmable thermostats were well-known (as the '394 patent admits at 1:60-65) and would have been predictably used in addition to or instead of other microprocessor-based controllers, with no unexpected results.

E. Analogous Art

82. In my opinion, Hildebrand and Shah are analogous art because they

relate to energy management systems that track efficiency of heating/cooling systems (Ex. 1004, Abstract)(Ex. 1006, Abstract), they are in the same field as the '394 patent (building energy management and controls), and their teachings would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1004, Abstract)(Ex. 1006, Abstract)(Ex. 1001, Abstract).

F. Claim Mapping

83. This section maps the challenged claims to the relevant disclosures of Hildebrand and Shah and the relevant mapping follows the claim text. There is added numbering and lettering in brackets (*e.g.*, 1[a], [1b]) to certain claim elements, to facilitate the discussion. I address independent claims 1 and 10 first, followed by the dependent claims.

INDEPENDENT CLAIM 1

1[a]. A control system for an environment inside a structure, comprising:"

84. In my opinion, Hildebrand discloses this limitation.

85. Hildebrand's "Fig. 1 is a block diagram of a system," which is a **control system for an environment inside a structure**. (Ex. 1004, 3:21-54, 4:55-5:60). Specifically, Hildebrand's Fig. 1 system (the **control system**) includes an energy management apparatus 2 that "**control[s]**" a temperature modification device, an example of which is an HVAC system 12. (Ex. 1004, 1:11-18, 3:61-63, 4:1-10).

The energy management apparatus 2 operates the HVAC system 12 to “heat or cool a zone (such as the zone 18)” in a building (*id.*, 4:46-63), which is **an environment inside a structure** (*id.*, 3:61-4:54).

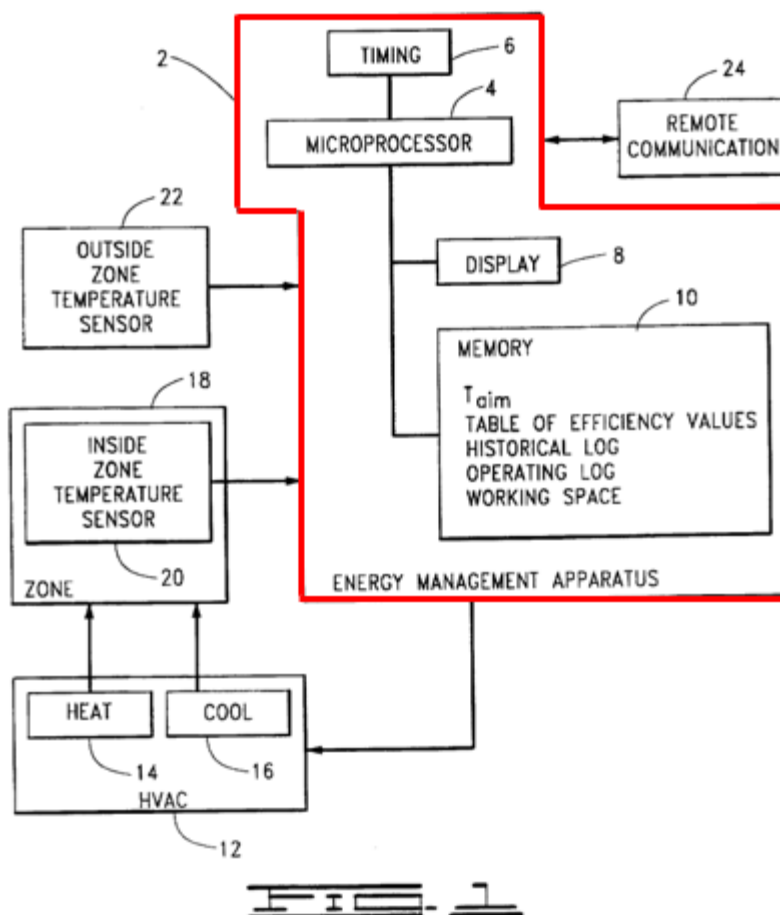
86. I note that Shah also describes a similar system, thus reinforcing the combinability of Shah and Hildebrand. (*See also* Ex. 1006, 8:37-43, 4:63-66, 3:35-37, Fig. 1).

“[1b] a climate control device in the structure that receives first temperatures from inside the structure;”

87. In my opinion, Hildebrand discloses and renders obvious this limitation.

88. Hildebrand teaches **a climate control device** in two principal alternative ways. I present alternative mappings, each of which is based on Hildebrand, in view of what I understand to be EcoFactor’s apparent litigation positions regarding this claim element. In my opinion, any of the recited mappings discloses and renders obvious this claim element.

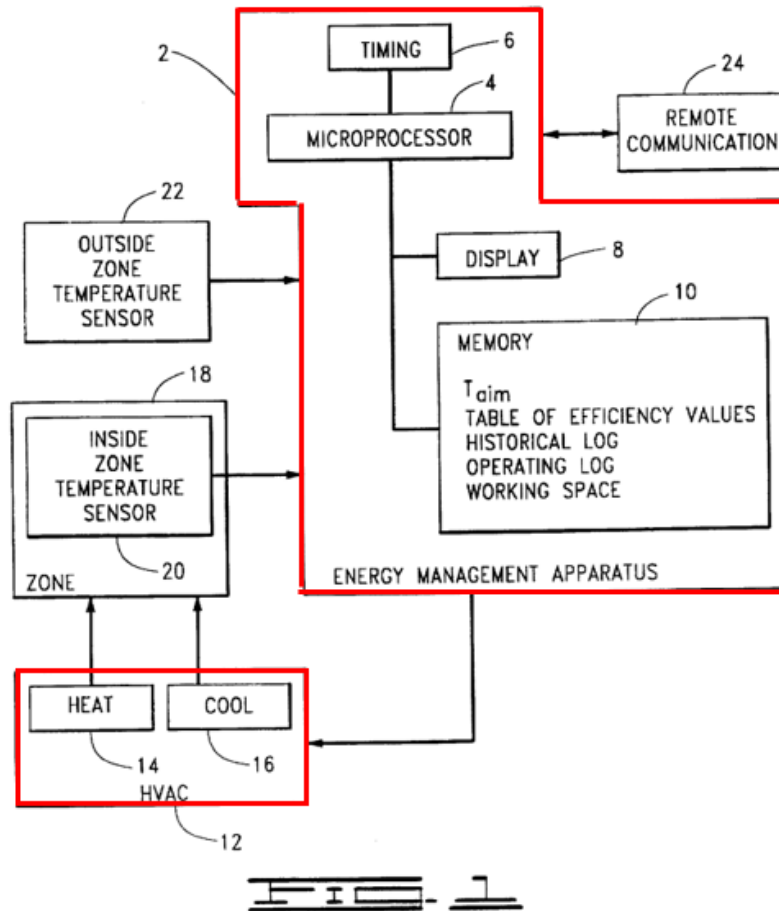
89. In a first mapping, Hildebrand’s energy management apparatus 2 (outlined in red below) is a **climate control device**:



(Ex. 1004, Fig. 1, 3:41-43). This mapping is based on EcoFactor's apparent litigation interpretation that the climate control device is a device that operates, but excludes, the HVAC equipment (Ex. 1027, p.12). Based on this interpretation, Hildebrand's energy management apparatus 2 is a **climate control device** because it operates the HVAC equipment to control the climate in the zone to maintain particular temperatures. (Ex. 1004, 2:55-67, 5:3-10, 5:40-44).

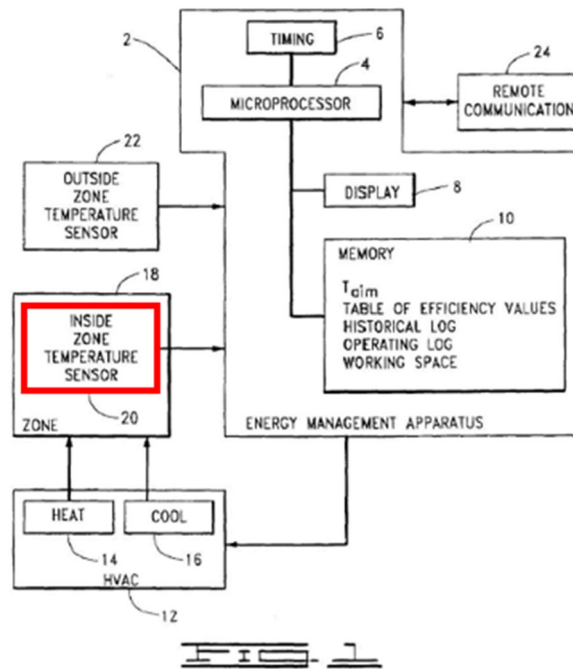
90. In a second mapping, Hildebrand's energy management apparatus 2 and HVAC system 12, together form a **climate control device** (outlined in red

below) because together, they operate to control the climate of the zone:



(Ex. 1004, Fig. 1, 3:41-43).

91. Furthermore, and in the alternative, in either mapping, the inside zone temperature sensor 20 (whose input reflects and is used to control the climate in the zone) also forms a part of the **climate control device**.



(Ex. 1004, Fig. 1, 4:11-15).

92. In either of the above-recited mappings, the climate control device **receives first temperatures from inside the structure** because Hildebrand's energy management apparatus 2 receives temperatures from the "inside zone temperature sensor 20," which is inside the zone and building. (Ex. 1004, 4:11-14, 5:11-17, 6:12-16).

93. Moreover, in either mapping, the climate control device is **in the structure** because in Hildebrand, "the energy management apparatus 2 and the temperature sensors are... installed" "in a building." (Ex. 1004, 4:45-52). Further, the energy management apparatus 2 is **in the structure** because it is microprocessor-based and displays or provides a "hard copy printout" of efficiency calculations to

the user, which would have been performed inside the building, not outside. (Ex. 1004, 7:63-8:11, 1:64-2:10, Fig. 1).

94. For the second mapping, Hildebrand's HVAC system 12 is also **in the structure** because it is "implemented... in a building where the energy management apparatus 2 [is]... installed." (Ex. 1004, 4:45-52).

95. I note that Shah also discloses a similar system, thus reinforcing the combinability of Shah and Hildebrand. (See also Ex. 1006, 5:22-27, 7:27-33, 8:40-43, 8:63-67, 9:21-25, 9:56-10:2, 12:53-59, 9:1-11, 5:14-15, 5:27-30, claims 3, 10-11).

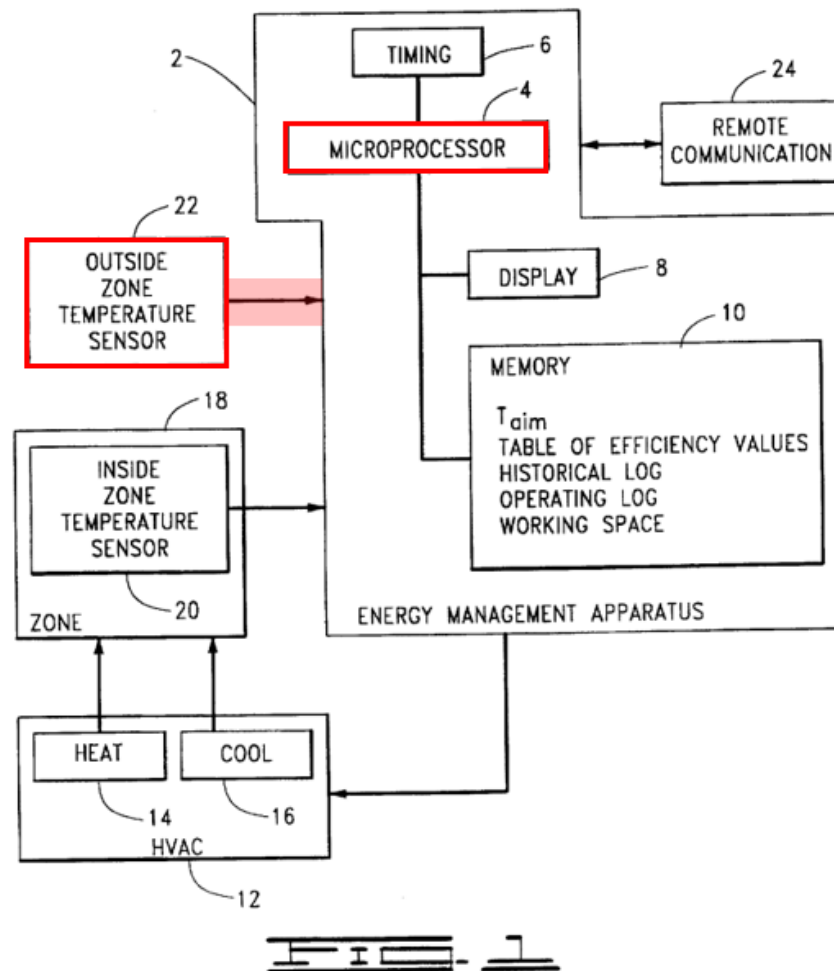
"[1c] a processor that: receives second temperatures from outside the structure from at least one source outside the structure; and"

96. In my opinion, Hildebrand discloses and renders obvious this limitation.

97. Hildebrand's microprocessor 4 is a **processor**, which performs Hildebrand's rate-of-change and efficiency calculations.⁴ (Ex. 1004, Fig. 1, 3:41-44, 4:55-64).

⁴ I am informed and understand that under EcoFactor's apparent litigation interpretation, the **processor** can be part of the **climate control device**. (Ex. 1027, pp.25-26)(see also Ex. 1001, 6:4-7:20, 7:31-49, 7:5-20, Figs. 2, 4).

98. Hildebrand's microprocessor 4 **receives** outside temperatures (T_{out} , **second temperatures**), which are **from outside the structure** because T_{out} is "the air temperature outside the building in which the zone 18 is defined."



(Ex. 1004, Fig. 1, 4:16-21, 5:65-6:5). The microprocessor 4 receives T_{out} because T_{out} is stored in memory 10 and is used in efficiency calculations (both tasks carried out by the microprocessor). (Ex. 1004, 5:65-6:28, 6:44-58, 7:18-23, 7:45-50, 14:32-48).

99. In Hildebrand, the microprocessor 4 receives T_{out} **from** the outside zone

temperature sensor 22, which is **at least one source outside the structure** because it is “outside the building in which the zone 18 is defined.” (Ex. 1004, Fig. 1, 4:16-21, 5:65-6:5). It is further obvious for the outside temperature sensor to be located **outside the structure** in order to most accurately measure the outside temperature.

100. I note that Shah also receives and uses outside temperatures, thus reinforcing the combinability of Shah and Hildebrand. (*See also* Ex. 1006, 1:59-67, 5:11-40, 7:22-33, 8:26-33, 8:44-9:11, 9:21-25, 9:64-67, 10:3-36, 14:33-44, claims 1, 3, 9-10).

“[1d] [a processor that: ...] compares the first temperatures and the second temperatures over time to calculate a current operating profile for the climate control device; and”

101. In my opinion, 1) Hildebrand alone or 2) in view of Shah teaches this limitation.⁵

Hildebrand

102. Hildebrand’s microprocessor 4 (**processor**) **compares** the inside (**first**) **temperatures and** the outside (**second**) **temperatures over time to calculate a current operating profile for the climate control device.**

103. Hildebrand’s microprocessor continuously monitors inside and outside temperatures over a period of time that the HVAC system 12 (connected to the

⁵ In my opinion, this claim language is unclear.

energy management apparatus for both mappings of [1b] and explicitly part of **the climate control device** in the second mapping for [1b]) is **operating**, and then uses the **temperatures** to calculate a **current** “present computed efficiency value” K for the corresponding outside **temperature**. (Ex. 1004, 2:29-61, 5:40-8:49). The efficiency values are for the energy management apparatus 2 because the apparatus calculates them from data that it receives and stores, and operation is controlled by the apparatus. (Ex. 1004, 4:35-6:11, 2:29-61).

104. Hildebrand calculates the efficiency values K as $\Delta t / |T_{\text{start}} - T_{\text{aim}}|$, where the time period Δt is “the amount of time [] it takes for the energized HVAC system 12 to change the actual temperature in the zone 18 from the respective T_{start} to the respective T_{aim} ,” and where Δt is divided by a temperature change ΔT occurring over that time period. (Ex. 1004, 6:26-64, 13:50-14:52, 5:11-17, 9:35-39).

105. Upon calculating the efficiency value (which is calculated using inside temperatures), Hildebrand’s microprocessor stores it in a table indexed by the corresponding outside temperature (**compares the first temperatures and the second temperatures**). (Ex. 1004, 6:65-7:17, 7:38-62, 6:17-40)(*see also* 1:58-2:3, 6:17-40, 7:45-55, 6:34-37). Hildebrand’s microprocessor repeatedly uses inside temperature and time to calculate a rate of change of inside temperature, at the current outside temperature for that particular time. (Ex. 1004, 12:66-13:37, 6:17-7:44). The result is a table with three columns (Ex. 1004, 7:45-62) for T_{out} , cooling

rates, and heating rates, which together describe the efficiency (for heating and cooling cases) for different outside temperatures, where the heating and cooling rates are for different times (**over time**). (*Id.*).

106. I understand that EcoFactor has previously admitted that Hildebrand's "efficiency values... can be collected and plotted over time." (Ex. 1018, p.27)(Ex. 1004, 1:59–2:10, 6:65–67).

107. In my opinion, the currently **calculate[d]** efficiency value together with its corresponding outside temperature form **a current operating profile for the climate control device** because they represent the "current actual rate at which the temperature modification device changes the sensed temperature" "for the then sensed at least one ambient condition" (T_{out}). (Ex. 1004, 6:65-7:17, 7:38-8:49).⁶ In

⁶ In my opinion, the '394 patent does not make clear what it considers to be an operating profile. To the extent "**current operating profile**" is described by the '394 Patent, in my opinion, it encompasses Hildebrand's efficiency because the '394 Patent's Fig. 8 embodiment discusses "efficiency" changes when the "HVAC system now requires significantly longer cycle times in order to try to maintain the same internal temperature" for a given "outside temperature." (Ex. 1001, 9:50-10:18; *see also* Figs. 6-7, 9-13, 9:1-13:61, element [1f] stating an operating profile is represented by a "temperature profile").

other words, the efficiency value indexed by outside temperature **profile[s]** how **the climate control device operat[es]** under **current** conditions.

108. Hildebrand calculates efficiency values multiple times per day—each time the HVAC system is “activate[d]” to change the indoor temperature. (Ex. 1004, 5:40-50). These multiple efficiency values together with corresponding outside temperatures for a current time period (*e.g.*, the current day) are also **a current operating profile** for the same reasons, namely, that they profile the operation of the climate control device for a current time period.

Hildebrand-Shah

109. In my opinion, the claimed comparison is also obvious in view of Shah. Shah **calculate[s] a[n] operating profile for the climate control device** by “determin[ing] τ_{sN} , the thermal time constant of the system on day N”:

$$\tau_{s,N} = \frac{[T_s - T_{oa}]_N}{[dT_s/dt]_N} \quad (5)$$

(Ex. 1006, 4:9-20, 3:21-5:10). Shah’s $\tau_{s,N}$ (indexed by day) is a representation or summary (**profile**) of the **operat[ion] of the climate control device** on a given day. (*Id.*). Both the numerator (“ $[T_s - T_{oa}]_N$ is the average temperature difference... during a time period when the space conditioning plant is ‘ON’”) and the denominator (“ $(dT_s/dt)_N$ is the time rate of change... during this same time period”) are computed when the **climate control device is operating**, and therefore are for

an **operating profile for the climate control device**. (*Id.*).

110. Shah's $\tau_{s,2}$ is a **current** operating profile because it is computed on any day after the day that $\tau_{s,1}$ is computed, including the **current** day, and includes the data for the "ON" cycles of the "space conditioning plant" (the heating/cooling equipment) for that day.

$$\tau_{s,2} = \frac{[T_s - T_{oa}]_2}{[dT_s/dt]_2} ; \quad (7)$$

(Ex. 1006, 4:9-49, 12:4-20). In my opinion, a PHOSITA would have understood and found obvious that, depending on the application, the $\tau_{s,N}$ values for the most recent set of days (e.g., the last seven days) together are also a **current operating profile** for the same reasons, namely, that they profile the operation of the climate control device for a current time period.

111. Shah calculates $\tau_{s,2}$ by **compar[ing] the first temperatures and the second temperatures over time**, as shown in the numerator of Equation (7). The difference $T_s - T_{oa}$ is a **compar[ison]** of the current sensed space temperature (**first temperature**) and outdoor air temperature (**second temperature**). (Ex. 1006, 4:9-20, 3:21-5:10). This comparison is performed **over time** because it "is the average temperature difference... during a time period when the space conditioning plant is 'ON'." (*Id.*).

112. Shah's processor 15 calculates τ , because it executes the program of

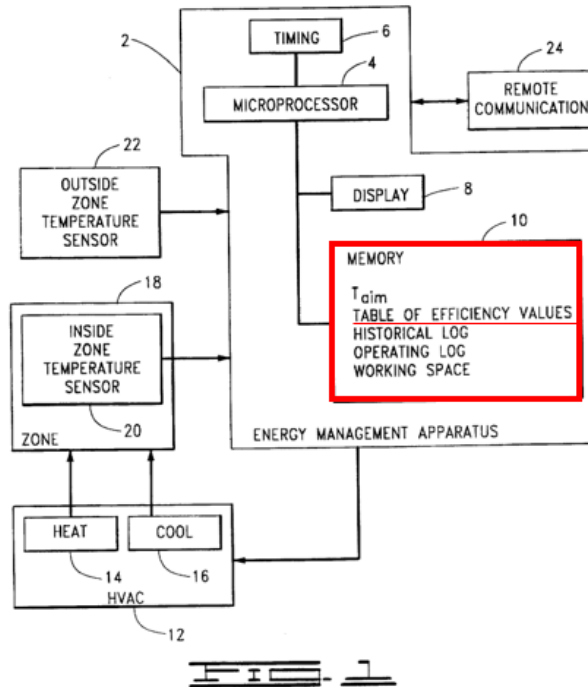
Figures 4A-4D, including the τ calculations (see elements 38 and 82 of Fig. 4A). (Ex. 1006, 10:3-5, 10:32-36, 11:59-61, 12:2-20, 7:22-33). In my opinion, it would have been obvious to incorporate the use of Shah's calculations into Hildebrand's system and for Hildebrand's microprocessor 4 (**processor**) to perform these calculations for the reasons set forth under the Motivation (Rationale) Supporting Obviousness section above.

“[1e] a database that stores the current operating profile for the climate control device,”

113. In my opinion, 1) Hildebrand discloses and renders obvious this limitation and 2) Hildebrand in view of Shah renders obvious this limitation.

Hildebrand

114. Hildebrand “store[s]” the calculated efficiency value “in the table of efficiency values retained in memory 10” and “in correspondence with the value of the sensed at least one ambient condition,” which is T_{out} . (Ex. 1004, 6:65-7:4). Hildebrand's table “is indexed by T_{out} so that the calculated efficiency value is stored at the index corresponding to the actually sensed T_{out} .” (*Id.*).



(Ex. 1004, 6:65-7:4, 3:63-67, 7:38-62, 9:35-39, 1:63-67).

115. In my opinion, because Hildebrand teaches that this data is stored in a table structure and indexed, Hildebrand teaches the claimed **database**. A PHOSITA would understand that this is a manner of storing data using an organizational structure. I understand that EcoFactor has previously admitted that Hildebrand provides organizational structure (*e.g.*, a table) for storing *efficiency values*. (Ex. 1018, pp.27-28). I also understand that the Board has also found that “[b]ecause the data [in Hildebrand] is stored in an indexed table, it is stored in a database.” (Ex. 1018, pp.31, 28-32)(*see also* Ex. 1033, 22:2-22).

116. In my opinion, to the extent that Hildebrand does not already disclose a database, a PHOSITA would also have found it obvious to implement Hildebrand’s

memory as a **database**, for storing efficiency values indexed with outside temperatures (**the current operating profile for the climate control device**) for the reasons set forth under the Motivation (Rationale) Supporting Obviousness section above.

Hildebrand-Shah

117. For the combination of Hildebrand and Shah, in my opinion, it would have been obvious to store Shah's τ values indexed by day (**current operating profile(s)**) in Hildebrand's memory 10 or another database for the reasons set forth under the Motivation (Rationale) Supporting Obviousness section above.

“[1f] wherein the processor (a) compares a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time, and”

118. In my opinion, 1) Hildebrand alone or 2) in view of Shah teaches this limitation.⁷

Hildebrand

119. In my opinion, Hildebrand's microprocessor 4 (**processor**) compares efficiency values (K) **to evaluate whether an operational efficiency of the climate**

⁷ In my opinion, this claim language is unclear.

control device has decreased over time. (Ex. 1004, 7:18-33, 2:29-3:6, 5:51-8:57, 2:2-10). Hildebrand explains:

“The present computed efficiency value is **compared** with a prior computed efficiency value which was computed contemporaneously with sensing ambient temperature... outside the zone at the same value of T_{out} and which was stored in the digital computer...”

(Ex. 1004, 7:18-33). In Hildebrand, if the present value exceeds the prior value (“the present value indicates it is taking longer to effect a 1° F. temperature change”), “this represents a decrease in efficiency of the HVAC equipment.” (*Id.*). Otherwise, if the prior value exceeds the present value (“representing a faster temperature change rate at the present calculation time”), “this represents an increase in efficiency of the HVAC equipment.” (*Id.*). In Hildebrand, the same values “represent unchanged efficiency.” (*Id.*).

120. By comparing the present efficiency with a prior efficiency, Hildebrand “determin[es] whether the efficiency of the HVAC system changes over time,” which, in my opinion, **evaluate[s] whether an operational efficiency of the climate control device has decreased over time.** (Ex. 1004, 2:29-61)(*see* claim element [1d] analysis).

121. Hildebrand’s “efficiency value” is or represents **an operational efficiency of the climate control device** because it represents how efficiently the energy management apparatus 2, alone or together with the HVAC system, is

operating. (Ex. 1004, 2:29-51, 4:35-5:60, 6:18-7:4). In my opinion, it also renders obvious EcoFactor's prior interpretation of **operational efficiency** for related patents because it represents a time to change the temperature in the zone for the given indoor and outdoor temperatures, and is therefore obviously a "time to change inside temperature by any given amount for a set of one or more indoor or outdoor conditions." (Ex. 1004, 6:26-64, 7:18-33)(*see* Ex. 1010, p.32). This is because Hildebrand's efficiency value represents a time to effect a change in inside temperature of some given amount. Furthermore, in my opinion, it would be obvious to express and understand Hildebrand's K value as a value in terms of time—e.g., the time needed to change the temperature by one degree or per ten degrees. (*See, e.g.,* Ex. 1004, 8:25-50).

122. Moreover, as discussed under claim element [1d], Hildebrand's "present computed" efficiency value(s) together with the corresponding outside temperature(s) is **a current operating profile for the climate control device**, so that Hildebrand's "present computed" efficiency value(s) is **a portion of the current operating profile for the climate control device**.

123. In my opinion, Hildebrand's "prior computed efficiency value" indexed by outside temperature is **a previous operating profile for the climate control device** for similar reasons above for the **current** operating profile, except that it represents a previous time (*see* above and claim element [1d]). (Ex. 1004, 7:18-33,

2:29-61, 5:51-8:57).

124. It is also my opinion that Hildebrand's "prior computed efficiency value" is also a **stored temperature profile that represents the previous operating profile** because it is stored in a table in Hildebrand's memory, and is a value that **profile[s]** how **the temperature** changes over time due to operation of the **climate control device**. (*See* claim element [1d] analysis). Similarly, the combination of Hildebrand's "computed efficiency value" along with the corresponding outside temperature is also the claimed **stored temperature profile** for similar reasons.

125. In my opinion, to the extent necessary, it would also be obvious to store inside temperatures (a **stored temperature profile**) in order to use them to compute Hildebrand's efficiency values. (Ex. 1004, 1:58-2:9, 5:11-17, 6:12-16, 6:65-7:4, col. 9).

126. Hildebrand's "prior computed efficiency value" indexed by outside temperature is **calculated at a different time** because it was computed at an earlier time, for example, one month prior to the current operating profile for the same outside temperature. (Ex. 1004, 2:29-61, 7:18-44, 8:25-50). In that example, the comparison of the current and prior efficiency values yielded a determination of "HVAC performance degradation" over that month, which is an **evaluat[ion] [of]** **whether an operational efficiency of the climate control device has decreased**

over time.

Hildebrand-Shah

127. In my opinion, this claim element also would have been obvious in view of Shah, as Shah's τ values have unit time and are used to **evaluate whether an operational efficiency** has decreased. In the Hildebrand-Shah combination, as set forth in the Rationale (Motivation) Supporting Obviousness section above, Shah's τ values are saved in a table indexed by day. Furthermore, as Shah discloses, the τ values are compared to each other in order to **evaluate whether an operational efficiency** has decreased.

128. Specifically, Shah calculates a metric ξ , which represents the ratio between two values for $\tau_{s,N}$ on different days:

$$\frac{\tau_{s,1}}{\tau_{s,2}} = \xi \quad (8)$$

$$\xi = \frac{\tau_{s,1}}{\tau_{s,2}} = \frac{[T_s - T_{oa}]_1 / [dT_s/dt]_1}{[T_s - T_{oa}]_2 / [dT_s/dt]_2} \quad (9)$$

(Ex. 1006, Eqs. 8-9, 4:21-5:10). According to Shah, ξ reflects any difference in $\tau_{s,N}$ on different days, and therefore "provides an ability to monitor the integrity of the thermal system" and can be used for "diagnostics purposes." (Ex. 1006, 4:9-20, 4:63-5:10). "Any degradation in the thermal performance of the system will be reflected in the value of ξ " because "the value of ξ will change to reflect [] change

in the building's thermal integrity.” (*Id.*). Thus, ξ reflects **whether an operational efficiency of the climate control device has decreased over time**, because it reflects changes in the system's ability to bring and maintain the building's temperature to a desired value.

129. The denominator of $\xi (\tau_{s,2})$ is **a portion of the current operating profile for the climate control device**. (Ex. 1006, 4:9-59). Also, in the case that the **current operating profile** is the set of $\tau_{s,N}$ values for the most recent set of days (e.g., the last seven days), $\tau_{s,2}$ is **a portion of the current operating profile**.

130. Moreover, the numerator of $\xi (\tau_{s,1})$ is **a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time**. I understand that EcoFactor has contended in litigation that a **stored temperature profile** is “based on temperatures over the previous weeks or months,” which is satisfied by $\tau_{s,1}$, as shown in Eqns. 9 and 5 (day 1 is any day occurring before day 2). (Ex. 1027, pp. 3-44)(Ex. 1006, 4:21-59). The value for $\tau_{s,1}$ is or represents **a previous operating profile for the climate control device calculated at a different time** because it is a thermal time constant from a day that is earlier in time than $\tau_{s,2}$. (Ex. 1006, 4:9-59). Because $\tau_{s,2}$ (computed on day 2) and $\tau_{s,1}$ (computed on day 1) “could be any two days with day 2 occurring after day 1,” $\tau_{s,1}$ is both **previous** and **calculated at a different time** from $\tau_{s,2}$. (Ex. 1006, 4:9-49, 12:4-20).

131. The value for $\tau_{s,1}$ is also a **stored temperature profile** because, as shown in Equation (6) and element 38 of Figure 4A, $\tau_{s,1}$ describes the rate of change of sensed temperature for a given set of inside and outside temperature conditions (see [claim element 1d]), and in the combination, it is stored in the same manner as $\tau_{s,2}$ (see claim element [1e]).

132. Shah's processor 15 "controls the entire operation of thermostat 12," including the comparison of τ values. (Ex. 1006, 10:3-5, 10:32-35). In my opinion, it would have been obvious to have Hildebrand's microprocessor (**the processor**) perform the steps performed by Shah's processor 15, including comparing Shah's τ values, for the reasons set forth under the Motivation (Rationale) Supporting Obviousness section above.

"[1g] [wherein the processor . . .] (b) outputs a result of the evaluation,"

133. In my opinion 1) Hildebrand alone or 2) in view of Shah teaches this limitation.

Hildebrand

134. In Hildebrand, "[i]f less efficient operation ... is indicated by the aforementioned comparison, a control signal is generated for initiating inspection of the temperature modification device" (**outputs a result of the evaluation**). (Ex. 1004, 7:63-8:11, 2:3-10 ("one or more signals for initiating corrective action are

generated”), 2:56-61, 8:45-49, Abstract, 7:63-8:11) (stating the signal is output “locally” or “remotely”).

135. This control signal “is generated and transmitted from the digital computer in the energy management apparatus 2” and specifically, “by the programmed microprocessor 4” (the **processor**). (Ex. 1004, 7:63-8:13).

Hildebrand-Shah

136. Similarly, Shah uses ξ “to monitor the integrity of the thermal system” for “diagnostics purposes.” (Ex. 1006, 4:63-5:10). In my opinion, in the combination with Hildebrand, it would similarly be obvious to output a result of the evaluation using Shah’s efficiency values in order to communicate the results of the analysis to a user, including to alert an operator to needed action, which could be, for example, to signal that efficiency has decreased such that maintenance should be performed.

“[1h] wherein: the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval.”

137. In my opinion, 1) Hildebrand alone or 2) in view of Shah teaches this limitation.

Hildebrand

138. Hildebrand’s “present computed efficiency value” (**the portion of the**

current operating profile) and “prior computed efficiency value” (alone or with the corresponding outside temperature) (**the stored temperature profile**) are **limited to specified time intervals**. This is because they are calculated at and for particular time periods. For example, Hildebrand’s “present computed efficiency value” is for one of the “predetermined periods of time during which the step of energizing is repeatedly performed,” which is **a specified first time interval**. (Ex. 1004, 2:29-34, 5:40-60, 6:18-8:12). In Hildebrand’s example of a +10° “recovery temperature change” during a “morning’s calculated recovery time [being] 120 minutes,” that 120 minute period is the **specified first time interval**, and the corresponding efficiency value of “12 minutes per °F” is the **portion of the current operating profile**. (Ex. 1004, 8:25-50).

139. Similarly, Hildebrand’s “prior computed efficiency value” (**stored temperature profile**) is **limited to a specified earlier second time interval** because it is computed for a prior (**earlier**) one of the “predetermined periods of time during which the step of energizing is repeatedly performed.” (Ex. 1004, 2:29-61, 5:40-60, 6:18-8:12). In Hildebrand’s example of a +10° “temperature change” over “60 minutes,” that 60 minute period is the **specified second time interval**, and is **earlier** because it occurs one month before the **specified first time interval** of 120 minutes. (Ex. 1004, 8:25-50).

Hildebrand-Shah

140. In my opinion, this claim limitation is also met by the combination of Hildebrand and Shah. In Shah, $\tau_{s,2}$ (**the portion of the current operating profile for the climate control device**) is limited to a specified first time interval because it is computed “during a time period when the space conditioning plant is ‘ON’” on day 2, and $\tau_{s,1}$ (**the stored temperature profile**) is limited to a specified earlier second time interval because it is computed “during a time period when the space conditioning plant is ‘ON’” on day 1. (Ex. 1006, 4:9-49, 12:4-20). Because $\tau_{s,2}$ (computed on day 2) and $\tau_{s,1}$ (computed on day 1) “could be any two days with day 2 occurring after day 1,” the **specified time interval** of $\tau_{s,1}$ is **earlier** from $\tau_{s,2}$. (Ex. 1006, 4:9-49, 12:4-20). In the Hildebrand-Shah combination, based on these teachings, it would be obvious to continue to also use Shah’s efficiency values in this manner.

CLAIM 10

141. Claim 10 is a restatement of claim 1 in method form.

“10[a]. A method for controlling an environment inside a structure, comprising:”

142. See claim 1, element 1[a]. The system in Hildebrand has a corresponding **method**. (Ex. 1004, Title, 1:5-9, 1:43-46)(see also Ex. 1006, Abstract, 7:22-8:12, claim 3)(Shah disclosing similar method).

“[10b] receiving, with a processor, first temperatures inside the

structure from a climate control device inside the structure;”

143. See claim 1, element [1b].

144. In Hildebrand, the inside temperatures are **receiv[ed]** **with** the **processor** (microprocessor 4). (Ex. 1004, 4:11-14, 5:11-17, 6:12-16). Hildebrand’s microprocessor receives the inside temperatures for storage in memory 10, and for efficiency calculations. (Ex. 1004, 2:7-28, 5:11-17, 6:12-16, 6:44-58, 5:51-7:44, 8:12-20).

145. According to EcoFactor’s apparent litigation interpretation that a device **receiv[es]** temperature data from a component within the device (Ex. 1027, p. 12), in my opinion, Hildebrand’s microprocessor 4 receives first temperatures **from the climate control device** (including the energy management apparatus 2). Specifically, in order to perform efficiency calculations, the microprocessor 4 receives inside temperatures **from** the memory 10, which is part of **the climate control device**. Furthermore, because the inside zone temperature sensor 20 can also be considered to be part of the **climate control device** (see claim element [1b]), Hildebrand’s microprocessor 4 also **receive[s]** inside temperatures from the inside zone temperature sensor 20. (Ex. 1004, 5:11-17).

146. Alternatively, in my opinion, it would have been obvious to implement Hildebrand’s efficiency calculations using a remote processor (away from and outside of the **climate control device**) that communicates with the energy

management apparatus 2, such that the remote processor (**processor**) receives the temperatures **from the climate control device**. The use of remote processing capabilities (e.g., at a central server) in the context of HVAC system control was a known technique and would have provided the benefit of allowing a remote processor to split processing power over multiple devices, and reducing the processing power required at the local device. (See, e.g., Ex. 1008, 11:5-18)(Ex. 1004, 4:23-34, 5:3-10, 8:1-4).

“[10c] receiving, with the processor, second temperatures outside the structure from at least one source outside the structure;”

147. See claim 1, element [1c].

“[10d] comparing, with the processor, the first temperatures and the second temperatures over time to calculate a current operating for the climate control device; and”

148. See claim 1, element [1d].

“[10e] storing, with the processor, the current operating profile for the climate control device in a database,”

See claim 1, elements [1e], [10b].

Hildebrand

149. Hildebrand’s microprocessor 4 (**processor**) is responsible for **storing the current operating profile** in the memory 10 which is a **database**, or would be

obvious to implement as a database. (Ex. 1004, 4:11-14, 5:11-17, 6:12-16, 6:44-58).

Hildebrand-Shah

150. In the Hildebrand-Shah combination, it also would have been obvious to use Hildebrand's **processor** to store the current operating profile determined using Shah's calculations in memory 10, which is a database, or would be obvious to implement as a database as explained under claim element [1e].

“[10f] comparing, with the processor, a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time, and”

151. See claim 1, element [1f].

“[10g] outputting, with the processor, a result of the evaluation,”

152. See claim 1, element [1g].

“[10h] wherein: the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval.”

153. See claim 1, element [1h].

CLAIMS 2 AND 11

“2. The control system of claim 1, wherein the first temperatures are received from a programmable thermostat located inside the

structure communicating with the climate control device.”

“11. The method of claim 10, wherein the processor receives the first temperatures from a programmable thermostat located inside the structure communicating with the climate control device.”

154. In my opinion, 1) Hildebrand alone or 2) in view of Shah renders obvious both claims.⁸

Hildebrand

155. Hildebrand discloses thermostats and microprocessor-based HVAC system controllers, which a PHOSITA would have understood to include a **programmable thermostat**. (Ex. 1004, 1:10-17, Fig. 1, 4:11-15)(see Ex. 1006, 1:59-67)(see also Ex. 1001, 1:60-65).

156. For both claims, under EcoFactor’s apparent litigation interpretation that a device can **receive** data from a component within the device itself and therefore communicate with itself (Ex. 1027, p.12), in my opinion, it would have been obvious to implement Hildebrand’s energy management apparatus in the form of a **programmable thermostat** as part of Hildebrand’s energy management apparatus (thus forming a part of the **climate control device**), because both devices

⁸ I note that the ’394 patent acknowledges that programmable thermostats were well-known in the relevant timeframe, and would conventionally include sensors that “measure temperature” (**first temperatures**). (Ex. 1001, 1:60-65).

perform the same functions of controlling HVAC equipment to turn on or off based on inside temperature data. In such a configuration, inside temperatures (**first temperatures**) are **received** from the inside temperature sensor in the **programmable thermostat** and which forms a part of and **communicates** with the **climate control device**.

157. Alternatively, for both claims, in my opinion, it would have been obvious to implement Hildebrand's inside zone temperature sensor 20 as part of a **programmable thermostat** which **communicates** with Hildebrand's energy management apparatus. When sensor 20 is implemented as an inside temperature sensor located in a **programmable thermostat**, it **communicat[es]** the inside temperatures (**first temperatures**) to the energy management apparatus 2 (forming the **climate control device** alone or together with the HVAC system) or more specifically, to its microprocessor 4 (**the processor**). The sensor 20 is also positioned within the inside zone of the building, so that the **programmable thermostat** is **located inside the structure**. Much like the sensor 20 can be considered to form a part of the **climate control device**, so too can the **programmable thermostat** such that in this configuration, the inside temperatures (**first temperatures**) are received from the **climate control device**.

Hildebrand-Shah

158. Shah discloses a **thermostat** 12 that includes a temperature sensor 23

and is **programmable** because its operation is “controlled by a microprocessor 13 which includes an instruction processor 15,” and it is programmed by the user with keyboard 22. (Ex. 1006, 8:44-48, 9:12-38, 9:59-64, 1:59-67).

159. The proposed modifications involving the use of a programmable thermostat (such as that taught by Shah) are obvious for the reasons set forth under the Motivation (Rationale) Supporting Obviousness section above.

CLAIMS 3 AND 12

“3. The control system of claim 1, wherein the evaluation of the operational efficiency of the climate control device detects a change in an overall operating profile of the climate control device between the specified first time interval and the specified earlier second time interval.”

“12. The method of claim 10, wherein the evaluation of the operational efficiency of the climate control device comprises the processor detecting a change in an overall operating profile of the climate control device between the specified first time interval and the specified earlier second time interval.”

160. In my opinion, 1) Hildebrand alone or 2) in view of Shah discloses and renders obvious these claims.⁹

Hildebrand

161. In my opinion, Hildebrand’s present and prior efficiency calculations and corresponding T_{out} data (**current and previous operating profiles**) together

⁹ In my opinion, this claim language is unclear.

form an **overall operating profile of the climate control device**. Hildebrand's entire table of efficiency calculations and corresponding Tout data forms an overall operating profile of the climate control device for the same reasons. Hildebrand **detects a change in the overall operating profile** in at least two ways.

162. First, because Hildebrand updates its table of efficiency values to have "the actual rates representing the most efficient operation," Hildebrand detects an improvement in the **climate control device's** operation, which is a **change** in its **overall operating profile between** the current time (**specified first time interval**), and the prior time (**specified earlier second time interval**). (Ex. 1004, 7:34-44, claim 6).

163. Second, when Hildebrand determines "HVAC performance degradation" has occurred by comparing the **current** and **previous** efficiency calculations, it **detects a change** in the **overall operating profile between** the current time (**specified first time interval**), and the prior time (**specified earlier second time interval**). (Ex. 1004, 8:28-50).

164. For claim 12, Hildebrand's **processor** (microprocessor 4) performs the claimed **detect[ing]** because the microprocessor 4 performs tasks involving efficiency calculations and comparisons. (Ex. 1004, 2:29-51, 5:51-7:44, 8:12-20).

Hildebrand-Shah

165. Similarly, in my opinion, Shah's indexed current and historical τ values

together form an overall operating profile of the climate control device. The evaluation of the operational efficiency of the climate control device (see [1f]) between the specified first and second time intervals (see [1h]) would have involved detecting a change in τ (e.g., via Shah's ξ value). Furthermore, it would have been obvious for Hildebrand's microprocessor to perform the claimed detecting in Hildebrand-Shah combination.

CLAIMS 5 AND 14

“5. The control system of claim 2, wherein the programmable thermostat includes a display device, and the result of the evaluation is displayed on the display device of the programmable thermostat.”

“14. The method of claim 11, wherein the programmable thermostat includes a display device, the processor outputs the result of the evaluation in a format to be displayed on the display device of the programmable thermostat.”

166. As discussed for claims 2/11, in my opinion, it would have been obvious to implement Hildebrand's energy management apparatus 2 to include a **programmable thermostat**, or to implement Hildebrand's sensor 20 as part of a **programmable thermostat**.

167. Hildebrand's energy management apparatus 2 already includes a display 8 (**a display device**) that displays a message for initiating inspection of the temperature modification device (**the result of the evaluation is displayed on the display device**). (Ex. 1004, 7:63-8:11 (describing the “control signal [] generated

for initiating inspection” is transmitted to display 8)). It would have therefore been obvious to display the same message or a similar message on the **display device of the programmable thermostat**, regardless of whether the energy management apparatus 2 includes the thermostat, or whether the sensor 20 is part of a thermostat, as it would have been desirable for the user to be able to view such information from any available display relating to HVAC operation. (Ex. 1004, 7:53-8:20).

168. For claim 14, in my opinion, the PHOSITA would have appreciated that Hildebrand’s **processor** (microprocessor 4) **outputs** the result **in a format** suitable for display because the microprocessor 4 controls the display using “address, data and control buses.” (Ex. 1004, 3:46-54).

Hildebrand-Shah

169. Shah’s programmable thermostat has a display unit 21 (**display device**), which displays information “about the thermostat 12 operation.” (Ex. 1006, 1:59-67, 9:11-22). In my opinion, it would have similarly been obvious to **output** the result **in a format** suitable for display on a programmable thermostat such as that taught by Shah.

XI. GROUND 2: CLAIMS 1-5, AND 10-14 ARE OBVIOUS OVER HILDEBRAND AND SHAH IN VIEW OF ROSEN.

170. In my opinion, claims 1-5 and 10-14 are obvious over Hildebrand and Shah in view of U.S. Pat. No. 6,789,739 (“Rosen”)(Ex. 1009).

171. I understand that Rosen was made of record in the application leading

to the '394 patent, but was never expressly analyzed or applied in a rejection.

A. Effective Prior Art Date of Rosen

172. **Rosen** is U.S. patent that issued on September 14, 2004, and I understand that it is thus prior art.

B. Overview of the Combination

173. Hildebrand and Shah are applied in the same manner as in Ground 1, the entirety of which is incorporated herein, with the following additions.

174. First, with respect to claims 2/11 and 5/14, Rosen teaches a programmable thermostat with an inside temperature sensor and display. It would have been obvious to use Rosen's programmable thermostat to obtain inside temperatures and to display the result of Hildebrand's evaluation.

175. Second, with respect to claims 1/10 and 4/13, Rosen teaches obtaining outside temperatures over the Internet from a weather data provider. It would have been obvious to receive outside temperatures over the internet per Rosen and use those outside temperatures as the "second temperatures outside the structure" from a source outside the structure (claim limitations [1c] and [10c]) and in efficiency calculations instead of the inputs from Hildebrand's outside temperature sensor.

1. Overview of Rosen

176. Rosen discloses a programmable thermostat with climate control intelligence. (Ex. 1009, 3:3-17). The thermostat has a processor, a temperature sensor, and a liquid crystal display. (Ex. 1009, 3:3-17).

177. Rosen's programmable thermostat communicates over the Internet to a weather service provider. (Ex. 1009, 4:4-15). The weather service provider provides data including current outdoor temperature, localized to a particular geographic region based on, *e.g.*, a ZIP code. (Ex. 1009, 4:40-49, 7:58-8:11).

C. Rationale (Motivation) Supporting Obviousness

178. **(Programmable Thermostat):** With respect to claims 2/11, and 5/14, as explained in Motivation (Rationale) Supporting Obviousness for Ground 1, it would have been obvious to a PHOSITA to implement Hildebrand's energy management apparatus to include a programmable thermostat, or to implement Hildebrand's inside temperature sensor to be part of a programmable thermostat.

179. Rosen teaches a programmable thermostat that 1) includes an internal temperature sensor that measures inside temperature; and 2) allows users to adjust temperature setpoints for different zones, both described as conventional aspects of the thermostat. (Ex. 1009, 1:18-55, 2:2-6, 3:13-53, Fig. 1). Similarly, Hildebrand uses a "conventional sensor" to measure temperature and further defines "a setpoint... for each zone 18 wherein temperature control is to be effected," and explains setpoints are provided by users in a "known manner." (Ex. 1004, 4:11-15, 4:61-5:10).

180. **(Internet Weather):** With respect to claims 1/10 and 4/13, in my opinion, it would have been obvious to a PHOSITA to receive outside temperature

information using Rosen's internet weather service as an alternative source to (or together with) Hildebrand's outside sensor 22 and for Hildebrand's processor to use such information in efficiency calculations. Hildebrand measures outdoor temperature using a sensor, and connects its energy management apparatus to a remote network, and Shah uses an outdoor temperature sensor 17. (Ex. 1004, 4:16-34, 7:63-8:20)(Ex. 1006, Fig. 1). In Rosen, "local current weather information sources are widely available and are routinely accessed by, for example, using the Internet." (Ex. 1009, 4:10-15). As the '394 Patent admits, it was well-known to receive outside temperature via the Internet from weather websites. (Ex. 1001, 5:39-44)(outside temperature information is "widely available from various sources" including the Internet).

181. Using Rosen's internet weather service as a source of outside temperatures would have been beneficial by saving cost and time associated with installing outdoor temperature sensors on-site, which can be faulty or unreliable due to their placement, and is sometimes difficult or impossible. A PHOSITA would have understood the need for accurate outside temperatures (to accurately index Hildebrand's table of efficiency values), and a PHOSITA would have been motivated to look to other means of providing such data without the need for a user to purchase and install an outdoor sensor, which increases the cost and complexity of the system. Rosen provides a simple means to do so, by having a thermostat

programmed with the structure's ZIP code, which it provides over the Internet to a weather data provider. (Ex. 1009, 7:19-45, 6:50-61, 2:31-39, 7:58-8:41, 4:40-59).

D. Reasonable Expectation of Success

182. In my opinion, a PHOSITA in the relevant timeframe would have had a reasonable expectation of success in implementing the combination.

183. **(Programmable Thermostat):** For the same reasons as in Ground 1, in my opinion, the PHOSITA would have had a reasonable expectation of success implementing Hildebrand and Shah with Rosen's programmable thermostat to obtain inside temperatures and to display the result of Hildebrand's evaluation because the implementation is merely combining prior art elements according to known methods to yield predictable results (*i.e.*, using the thermostat that provides the inside temperature data and displays evaluations, to save on cost). Programmable thermostats were well-known (as the '394 patent admits at 1:60-65) and would have been predictably used in addition to or instead of other microprocessor-based controllers, with no unexpected results.

184. **(Internet Weather):** A PHOSITA would have also had a reasonable expectation of success in receiving and using outside temperature information from Rosen's internet weather service, because doing so merely combines prior art elements according to known methods to yield predictable results (*i.e.*, an internet weather service as a source for outside temperatures), with no unexpected results.

E. Analogous Art

185. In my opinion, Rosen is analogous art because it is in the same field as the '394 patent (building energy management and controls), and its methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1001, Abstract)(Ex. 1009, 2:1-39).

F. Claim Mapping

186. Claims 1 and 10 (and 3/12) are mapped to the prior art in Ground 1, with the changes to limitations [1c] and [10c] discussed in the overview.

CLAIMS 2 AND 11

“2. The control system of claim 1, wherein the first temperatures are received from a programmable thermostat located inside the structure communicating with the climate control device.”

“11. The method of claim 10, wherein the processor receives the first temperatures from a programmable thermostat located inside the structure communicating with the climate control device.”

187. In my opinion, Hildebrand and Shah in view of Rosen render obvious these claims for the same reasons as articulated for Ground 1 (and the Motivation (Rationale) Supporting Obviousness section above), by implementing Hildebrand's energy management apparatus 2 to include a **programmable thermostat**, or by implementing Hildebrand's sensor 20 as part of a **programmable thermostat**.

188. Rosen discloses a **programmable thermostat** that is **located inside the structure** and has an indoor temperature sensor 5 for measuring the **first**

temperatures. (Ex. 1009, 2:2-6, 1:17-28, 3:3-53, 6:62-7:9, Fig. 1). Rosen also teaches that users can program the thermostat with desired setpoint schedules. (*Id.*).

CLAIMS 4 AND 13

“4. The control system of claim 1, wherein the second temperatures comprise outside air temperatures for a geographic region surrounding the structure measured by one or more sensors positioned remotely from the structure.”

“13. The method of claim 10, wherein the second temperatures comprise outside air temperatures for a geographic region surrounding the structure measured by one or more sensors positioned remotely from the structure.”

189. In my opinion, Hildebrand and Shah in view of Rosen renders obvious these claims.

190. Rosen obtains outside temperatures (**second temperatures comprise outside air temperatures**) from an online weather service, and those temperatures are localized to **a geographic region surrounding the structure**, *e.g.*, by ZIP code. (Ex. 1009, 7:19-57). In my opinion, as the PHOSITA would have readily understood, Rosen’s “local current weather information” is obviously measured by **one or more sensors positioned remotely from the structure** because they are outside and away from the structure. (Ex. 1009, 4:10-15).

191. In my opinion, it would be obvious for Hildebrand’s microprocessor 4 (**processor**) to receive these outside temperatures via Hildebrand’s remote communication unit so that the outside temperatures can be used in efficiency

calculations performed by the processor. (Ex. 1004, 4:23-33).

CLAIMS 5 AND 14

“5. The control system of claim 2, wherein the programmable thermostat includes a display device, and the result of the evaluation is displayed on the display device of the programmable thermostat.”

“14. The method of claim 11, wherein the programmable thermostat includes a display device, the processor outputs the result of the evaluation in a format to be displayed on the display device of the programmable thermostat.”

192. In my opinion, Hildebrand and Shah in view of Rosen renders obvious these claims for similar reasons as articulated for Ground 1. *See, supra*, Ground 1, claim 5. Moreover, Rosen’s **programmable thermostat** includes a liquid crystal display (**a display device**) for displaying outputs of determinations, and in my opinion, it would have been obvious to use it to display the **result of the evaluation in a format to be displayed**. (Ex. 1009, 3:3-17, 4:40-59)(Ex. 1004, 7:63-8:11).

XII. GROUND 3: CLAIMS 1-3, 5-6, 10-12, AND 14-15 ARE OBVIOUS OVER HILDEBRAND AND SHAH IN VIEW OF VAN OSTRAND.

193. In my opinion, claims 1-3, 5-6, 10-12, and 14-15 are obvious over Hildebrand and Shah in view of U.S. Pat. App. Pub. 2005/0159846 A1 (“Van Ostrand”)(Ex. 1007).

194. I understand that Van Ostrand was made of record in the application leading to the ’394 patent, but was never expressly analyzed or applied in a rejection.

A. Effective Prior Art Date of Van Ostrand

195. **Van Ostrand** is a U.S. patent publication that published on July 21, 2005, and I understand that it is thus prior art.

196. I note that I am one of the named inventors on the Van Ostrand prior art.

B. Overview of the Combination

197. Hildebrand and Shah are applied as set forth under Ground 1 (the entirety of which is incorporated herein) as to independent claims 1/10 and dependent claims 3/12, from which claims 6/15 respectively depend. They are also applied as in Ground 1 to dependent claims 2/11, and 5/14. In my opinion, it also would have been obvious to use Van Ostrand's method of using rates of change in inside temperature to suggest which components are failing with Hildebrand and Shah's teachings of monitoring degradation in operational efficiency to predict when maintenance is needed.

1. Overview of Van Ostrand

198. Van Ostrand infers whether a specific HVAC component is functioning properly, or identifies which component has failed, based on efficiency values calculated as rate of change of the inside temperature of a structure (much in the same way as in Hildebrand). (Ex. 1007, ¶¶0029-0033, 0007).

199. In Van Ostrand, each heating and cooling device may have one or more "stages" of heating and/or cooling capacity. (Ex. 1007, ¶¶0019-0029, Fig. 1

(reproduced below))(See Ex. 1033, 18:8-19:15).

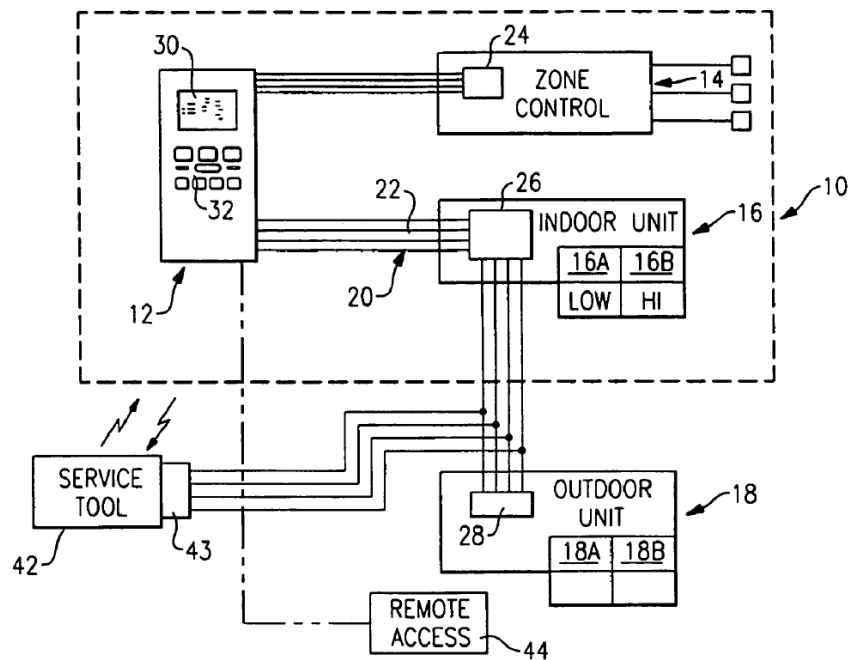


FIG.1

A single basic stage might be used for most heating or cooling needs, with additional (usually more expensive) stages of capacity being used for more extreme needs, depending on demand. (Ex. 1007, ¶0004).

200. Van Ostrand monitors the rate of change in inside temperature during operation to detect failed HVAC components or stages. (Ex. 1007, ¶¶0006-0007). The “slope to the controlled environment temperature vs. time” is the difference between inside temperatures divided by the span of time between the measurements (*i.e.*, $\Delta T/\Delta t$), or rate of change in inside temperature over a period of time. (Ex. 1007, Figs. 4 and 5, ¶¶0029, 0031).

201. Van Ostrand uses the rate of change in inside temperature in multiple

ways to monitor the operation of the HVAC system. Van Ostrand explains that

“[t]he central control 12 monitors the rate of change of a room temperature before and after it turns on the stage. If there is a change in the rate of change of room temperature, it can be inferred that the component is operating. If there is no change in the rate of change, the component can be assumed to be inoperative...”

(Ex. 1007, ¶0031). In other words, Van Ostrand first determines the rate of change of the temperature inside a structure during a first time period (before a stage or heating or cooling element is turned on). Van Ostrand then determines the rate of change of inside temperature over a second period of time (after a stage or heating or cooling element is turned on). (See Ex. 1007, Fig. 4, Fig. 5, ¶¶0029-0031). Van Ostrand then compares this first rate of change to the second rate of change to determine whether a specific component of the HVAC system has failed.

202. In addition to this method, Van Ostrand also “learn[s]” “the amount of change in the rate of change” over time and “[w]hen the system does not respond with the learned capacity, the controller 12 infers that there has been a failure”. (Ex. 1007, ¶¶0033, 0029-0031, 0014-0015, Figs. 4 and 5)(see additional discussion below).

C. Motivation (Rationale) for the Combination

203. In my opinion, a PHOSITA would have been motivated to use Van Ostrand’s technique—diagnosing the failure of HVAC components by using rates

of change—in Hildebrand, or in Hildebrand as modified by Shah. Hildebrand already teaches monitoring temperature data and rate calculations to detect when degradation in operational efficiency occurs, and initiates inspection of the HVAC equipment. (Ex. 1004, Abstract, 6:17-64, 7:63-8:20). Thus, much of the data needed to implement Van Ostrand’s diagnostic method is already present in Hildebrand and the Hildebrand-Shah combined system.

204. Van Ostrand’s “slope” is the temperature difference divided by time difference (*i.e.*, $\Delta T/\Delta t$). (Ex. 1007, Figs. 4 and 5, ¶¶0029, 0031). Hildebrand’s efficiency values K are the reciprocal of Van Ostrand’s slope: the time difference divided by the temperature difference. (Ex. 1004, 6:37-64, 13:50-14:52). Hildebrand expressly recognizes the efficiency value as a rate and a measure of operating efficiency. (Ex. 1004, 6:44-46, 6:56-58). In my opinion, a PHOSITA would have found it obvious that whether the ratio is expressed as time over temperature or the reciprocal, either expression is useful as a rate and a measure of efficiency.

205. Thus, Van Ostrand uses the same information as Hildebrand to diagnose when specific HVAC components or stages have failed. (Ex. 1007, ¶¶0005, 0007, 0029-0033, Figs. 4 and 5). In Van Ostrand, when the rate of change in inside temperature is lower than expected (*i.e.*, Hildebrand’s K value or Shah’s τ value is higher than expected), Van Ostrand uses such changes to, for example,

diagnose which specific HVAC stages have failed. (Ex. 1007, ¶0033). Adding Van Ostrand's diagnostic method to Hildebrand or Hildebrand-Shah would have been advantageous, as it would have provided users useful information concerning the source of the failure.

206. A PHOSITA would have recognized that Van Ostrand's teachings are applicable to HVAC systems having one or more stages. (Ex. 1007, ¶¶0019-0020, 0030)(See Ex. 1033, 18:8-19:15). Additionally, multi-stage systems were commonplace in the relevant timeframe, and, in my opinion, it would have been obvious to use "typical" multi-stage HVACs in Hildebrand or Hildebrand-Shah. (Ex. 1007, ¶0004)(Ex. 1033, 14:21-15:17). The combinability of the teachings of Hildebrand, Shah, and Van Ostrand does not turn on whether an HVAC system is multi- or single-stage.

207. Furthermore, it would have been advantageous to modify Hildebrand and Shah to calculate an efficiency value (rate of change) for each component or stage, to "'learn[]" the capacity of each state of the system," so that when a component or stage fails, the system can provide a specific diagnosis. (Ex. 1007, ¶¶0029-0033). This would have the advantage taught by Van Ostrand of specifically diagnosing which stage or component has failed. (Ex. 1007, ¶¶0029-0033).

208. Furthermore, in my opinion, Van Ostrand's technique represents a known method that can be used to improve a known system ready for improvement

(Hildebrand-Shah) in a predictable way, without unexpected results.

D. Reasonable Expectation of Success

209. In my opinion, a PHOSITA in the relevant timeframe would have had a reasonable expectation of success in combining Hildebrand, Shah, and Van Ostrand in each of the ways discussed in the Overview and Claim Mapping sections. In my opinion, the art was relatively predictable in the relevant timeframe (2007). Hildebrand, Shah, and Van Ostrand, moreover, are software-based systems that use well-known components, and were thus predictable in nature. Furthermore, in my opinion, Van Ostrand's technique represents a known method that can be used to improve a known system ready for improvement (Hildebrand or Hildebrand-Shah) in a predictable way, without unexpected results.

E. Analogous Art

210. In my opinion, Hildebrand, Shah, and Van Ostrand are analogous art because they are in the same field as the '394 patent (building energy management and controls), and their methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1004, Abstract)(Ex. 1006, Abstract)(Ex. 1001, Abstract)(Ex. 1007, Abstract).

F. Claim Mapping

CLAIMS 1, 2, 3, 5, 10, 11, 12 and 14

211. Hildebrand and Shah are as applied in Ground 1, including use of the same processor (see Ground 1, [1c]) and database (see Ground 1, [1e]) discussed.

Furthermore, as discussed above in the section entitled “Motivation (Rationale) Supporting Obviousness,” it would have been obvious to use the technique of Van Ostrand in Hildebrand or the combined Hildebrand-Shah system, including by forming and storing rates of change by stage.

212. Van Ostrand teaches comparing rates of change in inside temperature to determine whether the operational efficiency of the HVAC system has decreased over time. (Ex. 1007, ¶¶0007, 0029-0033, claim 12). Van Ostrand explains:

“[T]he central control detects the failed stages and/or components by monitoring the temperature of a controlled area to determine if any particular stage is operating properly. A higher stage having more capacity will create a more positive slope to the controlled environment temperature vs. time curve than a lower stage if the higher stage is properly operating.”

(Ex. 1007, ¶0007)(Emphasis added). The “slope to the controlled environment temperature vs. time curve” is a rate of change in inside temperature. (Ex. 1007, ¶¶0007, 0029-0031). Van Ostrand explains:

“The central control 12 monitors the **rate of change of a room temperature** before and after it turns on the stage. If there is a change in the **rate of change of room temperature**, it can be inferred that the component is operating. If there is no change in the **rate of change**, the component can be assumed to be inoperative (FIG. 5).”

(Ex. 1007, ¶¶0031)(Emphasis added).

213. Van Ostrand’s technique—which, in my opinion, would have been obvious to use with Hildebrand or Hildebrand-Shah—compares a portion of the current operating profile for the climate control device with a stored temperature profile that represents a previous operating profile for the climate control device calculated at a different time to evaluate whether an operational efficiency of the climate control device has decreased over time. This is because Van Ostrand’s rates of change (the slope of the temperature vs. time curve) are operating profiles (both current and previous) that indicate how the HVAC system “is operating.” (Ex. 1007, ¶¶0031, 0032-0034). As shown in Van Ostrand’s Figs. 4-5, Van Ostrand’s operating profiles (including the previous) are represent[ed] by “stor[ed]” rates of change that are slopes of temperature value over time (see Figs. 4-5), meaning they are stored temperature profile[s]. (Ex. 1007, ¶¶0032, 0029-0031, 0033). For example, a “learned” rate of change may be computed by monitoring temperature over time “over a number of cycles.” (Ex. 1007, ¶¶0033, 0032).

214. Alternatively, to the extent necessary, in my opinion, it would have been obvious based on the teachings of Hildebrand and Van Ostrand to use temperature values instead of rates of change values. In my opinion, a PHOSITA A PHOSITA would have been motivated based on Van Ostrand’s teaching of comparing rate values to compare the number of degrees traversed by the HVAC

operation over a given amount of time because doing so would provide the same information as comparing rate values, with the additional benefit of earlier detection of decreased HVAC efficiency. In this case, the temperature value (represented by the number of degrees traversed in units of temperature) associated with the ambient temperature (**a stored temperature profile**) would be compared in the same manner as with Van Ostrand's slope value.

215. Hildebrand teaches that one way to calculate **operating profiles** is by measuring the time to traverse a given number of degrees for identical ambient conditions. (Ex. 1004, 8:33-49). For example, a **previous operating profile** of 6 minutes per ° F at $T_{\text{out}} = 30^{\circ} \text{ F}$ may be computed by determining that a 10° F temperature change took 60 minutes for the HVAC system to traverse at $T_{\text{out}} = 30^{\circ} \text{ F}$. (*Id.*). Then, a **current operating profile** of 12 minutes per ° F at $T_{\text{out}} = 30^{\circ} \text{ F}$ may be computed by determining that the same 10° F temperature change took 120 minutes for the HVAC system to traverse at $T_{\text{out}} = 30^{\circ} \text{ F}$, which indicates that the operational efficiency has decreased over time. (*Id.*).

216. However, rather than waiting for the HVAC system to traverse the entire 10° F temperature change before signaling a potential problem with the HVAC, the PHOSITA would have been motivated to flag the potential HVAC problem as soon as such decreased efficiency is observable. (Ex. 1004, 7:63-8:31). Accordingly, in my opinion, the PHOSITA would have found it obvious, based on

the teachings of Hildebrand and Van Ostrand, to define the **operating profiles** by the degrees traversed over the same amount of time. In the example above, this could be accomplished by measuring the amount of temperature change at the 60 minute mark at $T_{\text{out}} = 30^{\circ} \text{ F}$. If the HVAC operation remains unchanged, the same amount of temperature change will be affected by the HVAC system over the 60 minutes. A lesser temperature change at the 60-minute mark would therefore indicate less efficient HVAC operation. In this manner, comparing the current and previous temperature change at the same ambient temperature provides the same information as the express rate comparison in Hildebrand, for purposes of identifying a decrease or increase in the efficiency of the HVAC system. (Ex. 1004, 7:5-33, 7:63-8:31). In my opinion, the PHOSITA would have been further motivated to modify Hildebrand to compare temperature changes at the 60-minute mark instead of waiting until the same temperature change is achieved, because a significantly degraded HVAC may not even be able to traverse the desired amount of temperature. As the PHOSITA would have recognized, in this case, it would have been undesirable to make the system wait indefinitely to achieve the desired temperature before flagging an issue. By observing temperature change at the 60 minute mark, significantly degraded HVAC problems would be flagged earlier.

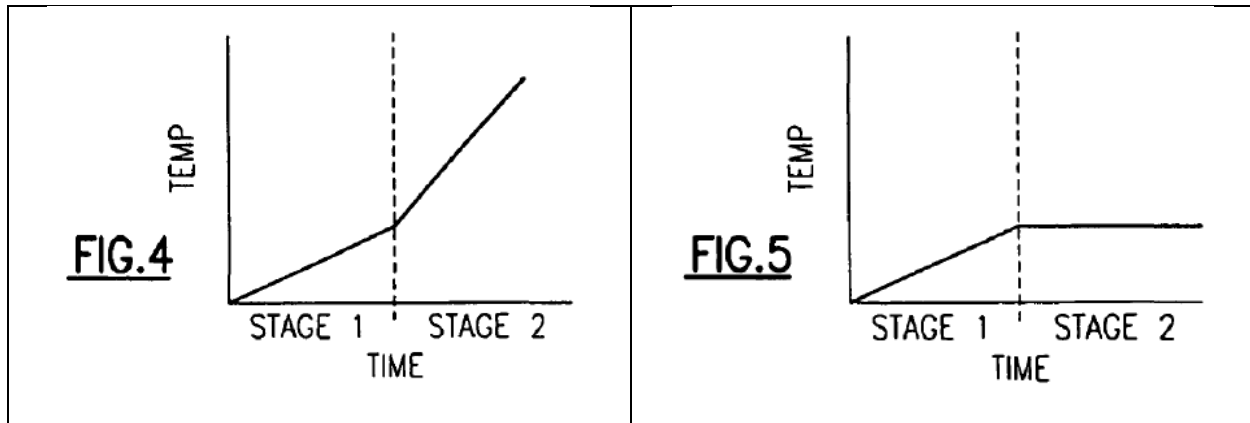
217. Van Ostrand's **current** and **previous** rates of change (**operating profiles**) are used to **evaluate whether an operational efficiency of the climate**

control device has decreased over time. (Ex. 1007, ¶¶0033, 0030-0032, 0029).

As Van Ostrand explains, its techniques “permit[] a **failure** in any one of several capacity producing components in a system to be found and identified.” (Ex. 1007, ¶0030)(Emphasis added). This is performed by **compar[ing]** the presently computed rate of change value to the “learned capacity” of the stage. (Ex. 1007, ¶¶0033, 0029-0032). When Van Ostrand identifies a failed component, it removes the failed component from the staging sequence (Ex. 1007, ¶0029) and provides an alert (Ex. 1007, ¶0033) (**outputs a result of the evaluation**).

218. Implementing Hildebrand and Shah’s efficiency values as Van Ostrand’s slopes also means that **the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval.**

219. For example, Van Ostrand identifies whether an HVAC’s second stage has failed by comparing its slopes, shown in Figs. 4 (normal operation during an **earlier second time interval**) and 5 (stage 2 malfunctioning during the **specified first time interval**), below:



Van Ostrand, Fig. 4

Van Ostrand, Fig. 5

(Ex. 1007, ¶¶0014-0015, 0029, 0033). The **earlier second time interval** may also be a time period over which the “learned” rate of change was aggregated “over a number of cycles.” (Ex. 1007, ¶0033). By monitoring the slope for a change between these two times (evaluat[ion] of an **operational efficiency... wherein: the portion of the current operating profile for the climate control device is limited to a specified first time interval, and the stored temperature profile is limited to a specified earlier second time interval**), Van Ostrand specifically diagnoses the malfunction of Stage 2 (**identifies that an operational efficiency of the climate control device has decreased over time**) from one time interval to another. (Ex. 1007, ¶¶0029-0031).

CLAIM 6

“6. The control system of claim 3, wherein:

[6a] the database stores a plurality of separate diagnostic temperature profiles associated with a plurality of potential defects identified by changes in the operational efficiency of the climate control device over time; and”

220. In my opinion, the combination of Hildebrand, Shah, and Van Ostrand renders obvious this limitation.¹⁰ As explained in the “Overview” Section, Van Ostrand teaches that a heating/cooling device can have one or more components or “stages” of heating/cooling capacity, where any component (including heating or cooling equipment) or stage can individually fail (**a plurality of potential defects**). (Ex. 1007, ¶¶0019-0030).

221. Van Ostrand detects failed stages/components by first monitoring the rate of change in inside temperature that occurs when a respective component or stage is supposedly operating, with higher stages generally having “a more positive slope to the controlled environment temperature vs. time curve.” (Ex. 1007, ¶¶0006-0007). Van Ostrand “learns” each component/stage’s rate of change (**a plurality of separate diagnostic temperature profiles**), which is store[d] in memory. (Ex. 1007, Figs. 4 and 5, ¶¶0029, 0031, 0033 (discussing “learned capacity”), claims 12-17). Each rate is a **temperature profile** because it represents a change in inside temperature over time, and is **diagnostic** because it is used in Van Ostrand to detect failure of a specific component or stage. The rates are therefore also **associated with a plurality of potential defects**, because they are used to identify which component (including the heating or cooling equipment)(see Ex. 1004, 2:2-7, 6:41-

¹⁰ In my opinion, this claim language is unclear.

64, 7:45-62) or specific stage has potentially failed, where each component or stage's potential failure is a **potential defect** of the system.

222. In Hildebrand or the combined system with Hildebrand-Shah, it would have been obvious to **store** these profiles in Hildebrand's table in memory or another similar database (**the database**, see element [1e]). Van Ostrand teaches that its rates of change are stored. (Ex. 1007, claims 12-17). It would have been obvious to store them in a database in order to track and organize them for later use in comparisons to detect degradations in efficiency.

223. It would have been obvious to implement Hildebrand and Shah's efficiency or τ values as Van Ostrand's rates of change for each component/stage, in which case the failed components (including the heating or cooling equipment) or stages are **identified by changes in the operational efficiency of the climate control device over time**. (See Ex. 1004, 2:2-7, 6:41-64, 7:45-62). The "amount of change in the rate of change is learned" over time for each properly functioning component/stage, and then, the component/stage's potential failure (a **potential defect**) is **identified** "[w]hen the system does not respond with the learned capacity" (**changes in the operational efficiency of the climate control device over time**) at a later time. (Ex. 1007, ¶¶0033, 0030-0032).

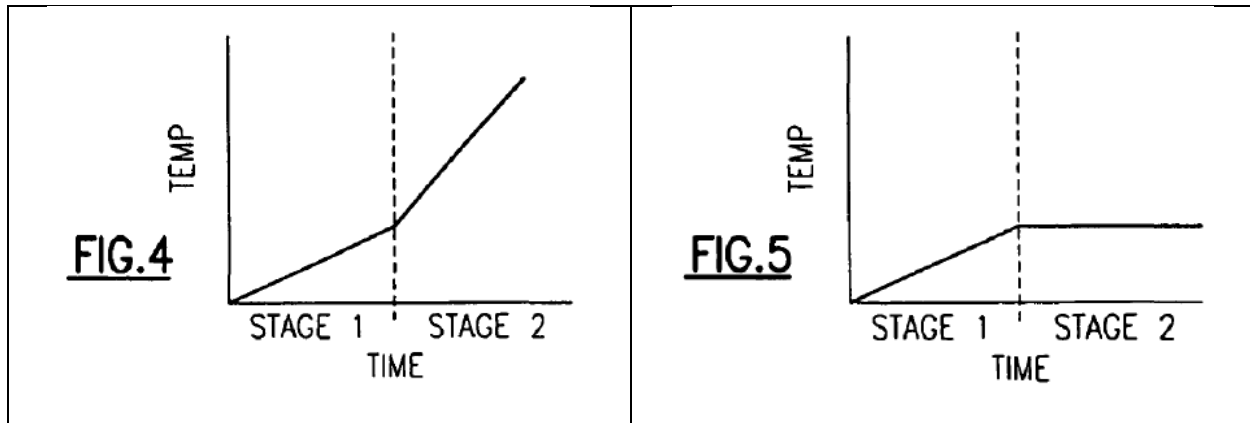
“[6b] the processor identifies one or more of the potential defects based on the evaluation of the operational efficiency of the climate control device between the specified first time interval and the

specified earlier second time interval.”

224. The combination of Hildebrand, Shah, and Van Ostrand renders obvious this limitation.¹¹ Van Ostrand compares a slope corresponding to a component or stage at different times to determine whether that component or stage has failed. (Ex. 1007, ¶¶0014-0015, 0029-0031). Using Hildebrand’s processor (see Ground 1, [1c]), implementing Hildebrand and Shah’s efficiency values as Van Ostrand’s slopes means that comparison is **the evaluation of the operational efficiency of the climate control device between the specified first time interval and the specified earlier second time interval**.

225. For example, Van Ostrand identifies whether an HVAC’s second stage has failed by comparing its slopes, shown in Figs. 4 (normal operation during an **earlier second time interval**) and 5 (stage 2 malfunctioning during the **specified first time interval**), below:

¹¹ In my opinion, this claim language is unclear.



Van Ostrand, Fig. 4

Van Ostrand, Fig. 5

(Ex. 1007, ¶¶0014-0015, 0029, 0031). By monitoring the slope for a change between these two times (**evaluation of the operational efficiency... between the specified first time interval and the specified earlier second time interval**), Van Ostrand specifically diagnoses the malfunction of Stage 2 (**identifies one or more of the potential defects**) from one time interval to another. (Ex. 1007, ¶¶0029-0031).

CLAIM 15

“15. The method of claim 12, wherein:

[15a] the database stores a plurality of separate diagnostic temperature profiles associated with a plurality of potential defects identified by changes in the operational efficiency of the climate control device over time; and”

226. See claim 6, element [6a].

“[15b] the processor identifies one or more of the potential defects based on the evaluation of the operational efficiency of the climate control device between the specified first time interval and the specified earlier second time interval.”

227. See claim 6, element [6b].

**XIII. GROUND 4: CLAIMS 1-6 AND 10-15 ARE OBVIOUS OVER
HILDEBRAND, SHAH, ROSEN AND VAN OSTRAND.**

228. Grounds 1-3 are fully incorporated herein. Claims 1-6 and 10-15 are further obvious in view of the combination of Hildebrand, Shah, Rosen, and Van Ostrand, which are applied as set forth above. In my opinion, a PHOSITA would have been motivated to combine Hildebrand, Shah, Rosen, and Van Ostrand and would have had a reasonable expectation of success in using the combination for the reasons set forth above. In my opinion, the addition of Van Ostrand does not change how a PHOSITA would consider the combination of Hildebrand, Shah, and Rosen (as set forth in Ground 2). The addition of Rosen does not change how a POSITA would consider the combination of Hildebrand, Shah, and Van Ostrand (as set forth in Ground 3).

**XIV. GROUND 5: CLAIMS 7-9 AND 16-18 ARE OBVIOUS OVER
HILDEBRAND, SHAH, ROSEN, AND VAN OSTRAND, FURTHER
IN VIEW OF MCNULTY**

229. In my opinion, claims 7-9 and 16-18 are obvious over Hildebrand and Shah, Rosen, and Van Ostrand, further in view of U.S. Pat. App. Pub. 2011/0251726 A1 (“**McNulty**”). (Ex. 1024).

230. I understand that McNulty was not of record in the application leading to the '394 patent.

A. Effective Prior Art Date of McNulty

231. **McNulty** is a U.S. patent application publication that published from a

national stage of a PCT application filed on May 3, 2007, which designated the US and published in English and I understand that it is thus prior art. (Ex. 1038).

B. Overview of the Combination and Motivation (Rationale) for the Combination

232. Hildebrand, Shah, Rosen, and Van Ostrand are applied as set forth under Grounds 1-4, (the entirety of which are incorporated herein) as to independent claims 1/10 and dependent claims 4/13, from which claims 7-9 and 16-18 respectively depend.

233. In my opinion, it also would have been obvious to modify an operating interval of the device during the process of setback recovery in view of an evaluation of operational efficiency according to Van Ostrand's teachings and further that it would be obvious to take into account forecasted outside temperatures in doing so per Rosen and McNulty.

234. The motivation to make the proposed modifications is discussed in detail in the claim-mapping section.

1. Overview of McNulty

235. McNulty teaches a climate control system in which "predicted weather conditions may be provided from [an] external source via the internet" and "predicted values from the weather forecast" can be used to predict how the temperature inside the structure will behave under such conditions ("the [inside] temperature sometime into the future can be predicted") in order to calculate control

parameters such as “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶¶0054, 0063, 0014, 0027).

C. Reasonable Expectation of Success

236. In my opinion, a PHOSITA in the relevant timeframe would have had a reasonable expectation of success in combining Hildebrand, Shah, Rosen, Van Ostrand, and McNulty in each of the ways discussed in the Overview and Claim Mapping sections. In my opinion, the art was relatively predictable in the relevant timeframe (2007). McNulty moreover, is a software-based system that uses well-known components, and was thus predictable in nature. Furthermore, in my opinion, McNulty’s techniques represent known methods that can be used to improve a known system ready for improvement in a predictable way, without unexpected results.

D. Analogous Art

237. In my opinion, Hildebrand, Shah, Rosen, Van Ostrand, and McNulty are analogous art because they are in the same field as the ’394 patent (building energy management and controls), and their methods would have been reasonably pertinent to the problems facing the named inventors. (Ex. 1004, Abstract)(Ex. 1006, Abstract)(Ex. 1007, Abstract)(Ex. 1009, Abstract)(Ex. 1024, Abstract)(Ex. 1001, Abstract).

E. Claim Mapping

CLAIMS 7 and 16

“7. The control system of claim 4, wherein another temperature profile is developed and stored as a prediction of a coming change in the second temperatures.”

“16. The method of claim 13, wherein another temperature profile is developed and stored as a prediction of a coming change in the second temperatures.”

238. These claims¹² are obvious in view of the combination of Hildebrand, Shah, Van Ostrand, and Rosen, further in view of McNulty.

239. As set forth under Ground 2, claim 4, it would have been obvious to receive outside temperature information using Rosen’s internet weather service and for Hildebrand’s processor to use such information in efficiency calculations. Rosen’s “local weather” includes current outside temperatures as well as forecasted outside temperatures (**another temperature profile is developed**) at a “time into the future” (**a prediction**) (Ex. 1009, 7:19-57, 2:9-12, 6:28-44). For example, Rosen teaches receiving “a predicted significantly low temperature,” which is a **prediction of a coming change in the second temperatures**. (*Id.*, 6:32-44).

240. McNulty similarly teaches that “predicted weather conditions may be provided from [an] external source via the internet” (**another temperature profile**

¹² In my opinion, this claim language is unclear. I have set forth alternative interpretations based on different possible meanings.

is developed) and specifically discloses that “predicted values from the weather forecast” (**prediction[s] of a coming change in the second temperatures**) can be used to predict how the temperature inside the structure will behave under such conditions (“the [inside] temperature sometime into the future can be predicted”) in order to calculate control parameters such as “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶¶0054, 0063, 0014, 0027).

241. In my opinion, it would be obvious in view of Rosen and McNulty to **store[]** such forecasted outside temperatures **as a prediction**, in order to use those forecasted temperatures to make predictive determinations using these values, including using the forecasted temperatures to make changes to the operation of the system, which take into account the **coming changes in second [outside] temperatures**. (Ex. 1009, 6:28-44, 2:9-12)(Ex. 1024, ¶¶0054, 0063, 0014, 0027)(*see* claims 8/17, *infra*). This use of forecast of outside temperature values is specifically motivated by McNulty who recognizes that predicted outside temperature values can be used in the control of the system, including to calculate “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶¶0054, 0063, 0014, 0027). A PHOSITA would readily recognize that one way in which such values can be used in Hildebrand or in Hildebrand-Shah is by using them as inputs for the relevant “outside temperatures” so as to obtain predictions of the system’s functioning given expected future outside temperatures.

242. To the extent that the claimed **another temperature profile** must represent an operating profile of the climate control device and/or must represent changes in indoor temperature over time, (*see* claim 1), this claim element is also obvious in view of the combination. Specifically, in my opinion, it would have been obvious to use forecasted outside temperatures in the computations of Hildebrand/Shah/Van Ostrand in place of current or previous outside temperatures in order to **develop and store a prediction** of how the inside temperature will behave in the future under forecasted outside temperature conditions (**a coming change in the second temperatures**)(Ex. 1009, 6:28-44, 2:9-12)(Ex. 1024, ¶¶0054, 0063, 0014, 0027).

CLAIMS 8 and 17

“8. The control system of claim 7, wherein the processor references the evaluation of the operational efficiency of the climate control device to modify an operating interval for the climate control device based on the prediction.”

“17. The method of claim 16, wherein the processor references the evaluation of the operational efficiency of the climate control device to modify an operating interval for the climate control device based on the prediction.”

243. In my opinion, these claims¹³ are obvious in view of the combination.

¹³ In my opinion, this claim language is unclear.

244. First, in my opinion, it would be obvious for the **claimed processor to reference[] the evaluation of the operational efficiency of the climate control device.**¹⁴ It would be obvious to take into account the previously determined **evaluation** in order to decide whether and how to **modify an operating interval for the climate control device**, as specifically taught by Van Ostrand.¹⁵

245. Van Ostrand teaches **modifying an operating interval for the climate control device** when **an evaluation of the operational efficiency of the climate control device** indicates certain changes. Van Ostrand specifically discloses **referenc[ing] of the evaluation of the operational efficiency of a climate control device** component or stage to be used during setback recovery. (Ex. 1007, ¶0035)(*See also* Ex. 1006, 1:7-3:20)(Shah reference discussing setback recovery)(Ex. 1004, 1:58-2:10, 8:33-50)(Hildebrand discussing setback

¹⁴ I assume for the purposes of this proceeding that “**the evaluation**” refers to claim 1’s **evaluat[ion] whether an operational efficiency of the climate control device has decreased over time.**

¹⁵ I interpret this claim language for the purposes of this proceeding as follows: “**[m]odify an operating interval for the climate control device**” refers to affecting or changing the operation of the climate control device during or over some duration of time.

recovery)(Ex. 1024, ¶0057)(McNulty discussing setback recovery). Van Ostrand teaches that based on **the evaluation**, the system modifies the necessary recovery time by modifying the time at which a stage or component is turned on (an **operating interval**) to begin recovery to a comfort temperature. (Ex. 1007, ¶0035).

246. In my opinion, it would also be obvious for this modification of an **operating interval** to be **based on the prediction**.¹⁶ As Van Ostrand states, the goal of a setback recovery is to “achieve a designated [indoor] temperature at a desired time.” (Ex. 1007, ¶0035). Setback recovery can involve the prediction of how the indoor temperature will change in advance of a desired time in the future. (See, e.g., Ex. 1006, 5:10-14, 2:47-67). For example, Shah explains that setback recovery can use an “assumed or predicted rate of cooling or heating during a recovery interval from an energy saving temperature.” (*Id.*). McNulty specifically teaches that “predicted values from the weather forecast” can be used to “estimate[]” “optimal start times and stop times” for a heating/cooling system. (Ex. 1024, ¶0063)(See also Ex. 1024, ¶0057). It would be obvious to utilize a forecast of the outdoor temperature to develop more accurate predicted rates of change of indoor

¹⁶ I interpret this claim language for the purposes of this proceeding as meaning that “**the prediction**” refers to claim 7’s **prediction of a coming change in the second temperatures**.

temperature (**operating profile[s]**) which take into account expected future outside temperatures, in order to predict more accurate future recovery times, (the time needed to return to a comfortable temperature after an energy-saving setback in temperature) and thereafter modify the time at which the recovery period begins. (Ex. 1007, ¶0035)(Ex. 1024, ¶¶0054, 0063, 0014, 0027, 0057)(Ex. 1009, 6:28-44, 2:9-12).

CLAIMS 9 and 18

“9. The control system of claim 8, wherein the processor modifies at least one of (a) an ‘on’ or an ‘off’ time for the climate control device, and (b) an ‘on’ or an ‘off’ temperature for the climate control device.”

“18. The method of claim 17, wherein the processor modifies at least one of (a) an ‘on’ or an ‘off’ time for the climate control device, and (b) an ‘on’ or an ‘off’ temperature for the climate control device.”

247. In my opinion, these claim elements are obvious from the combination. Modification of the time at which recovery is scheduled to begin (*see* claims 8/17) is **modifi[cation] of an “on” time for the climate control device** and modification of the time at which the climate control device stops running is an **“off” time**. In my opinion, a PHOSITA would readily recognize that this modification can also be implemented by changing the setpoint (both **an “on” temperature and an “off” temperature**) at a particular time so that the system begins to recover to ultimately achieve that setpoint temperature. A setpoint can be considered to be both an “on”

and an “off” temperature depending on the circumstances, because when a new setpoint is implemented, the system turns “on” to begin to change the temperature to achieve the setpoint, and then turns “off” once the setpoint has been achieved.

248. Furthermore, Hildebrand teaches that users may change (**modif[y]**) “via operator control” the “desired temperature setpoint” of the climate control device, and that changes are implemented using microprocessor 4 (**the processor**). (Ex. 1004, 4:64-5:10). For example, Hildebrand teaches the conventional functionality to “each morning... to bring the temperature for a controlled zone from its more energy conserving nighttime level to its more comfortable daytime level.” (Ex. 1004, 1:54-57, 8:25-50). Every daytime setpoint obviously includes at least an **“on” time for the climate control device**, and (b) an **“off” temperature for the climate control device**, while every nighttime setpoint obviously includes at least an **“off” time** and (b) an **“on” temperature**.

XV. OATH

249. This declaration and my opinions herein are made to the best of my knowledge and understanding, and based on the material available to me, at the time of signing this declaration. I declare under penalty of perjury under the laws of the United States of America that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements and the like are punishable by fine or

imprisonment, or both (18 U.S.C. 1001) and may jeopardize the validity of the application or any patent issuing thereon.

Date: 11/1/2024

Signed: Rajendra Shah