

ASHRAE TC 5.5 Air-to-Air Energy Recovery
ASHRAE 2024 Annual Meeting, Indianapolis, IN
June 25, 2024

Events	Time	Location
TC 5.5 Air-to-Air Energy Recovery Subcommittees Meeting	Wednesday, June 12 10:30 AM– 12 PM Eastern Time	Virtual Join the meeting now
TC 5.5 Air-to-Air Energy Recovery	Tuesday, June 25 3:30 PM - 5:30 PM Eastern Time	Indianapolis Join the meeting now

Agenda TC 5.5 Full Meeting

Hybrid Meeting

1. If you are unable to attend in person you can join virtually by using the links above.

Launch [20 minutes total]

2. Call to Order / Welcome

ASHRAE Code of Ethics:

“In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and we shall avoid all real or perceived conflicts of interests.

(Code of Ethics: <https://www.ashrae.org/about/governance/code-of-ethics>)

(Core Values: <https://www.ashrae.org/about/ashrae-s-core-values>)”

Recent CHANGES to the TC MOP requiring BALANCE for the voting membership removes the appearance of bias and conflict of interest. The most recent MOP can be found here: <https://www.ashrae.org/technical-resources/technical-committees> in the Procedures, Forms & Information for TCs/TGs/MTGs and TRGs section about half way down the page.

ASHRAE Commitment to Care

The health and safety of all ASHRAE conference attendees is a top priority. Out of respect for our fellow attendees, we commit to wear masks indoors, monitor our health, seek medical attention if symptoms develop and adhere to all ASHRAE Commitment to Care protocols. We are committed to the well-being of one another.

ASHRAE Value Statement – *In ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, inclusiveness and respect for others, which exemplify our core values of excellence, commitment, integrity, collaboration, volunteerism and diversity, and shall avoid all real or perceived conflicts of interest. Our culture is one of inclusiveness, acknowledging the inherent value and dignity of each individual. We celebrate diverse and inclusive communities, understanding that doing so fuels better, more creative and more thoughtful ideas, solutions and strategies for the Society and the communities our Society serves. We respect and welcome all.*

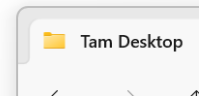
3. TC Scope

TC 5.5 is concerned with air-to-air heat exchangers, their application and cost benefit relationship. It includes consideration of the needs and procedures for standardization and testing, rating and terminology applicable to air-to-air energy recovery.

4. Introduction & Sign up (current email & updates)
5. Roll Call of Voting Members (exhibit 2)
6. Agenda Review and Adoption
7. Approval of Minutes
 - a. Winter Meeting, Hybrid, January 23, 2024
 - b. Minutes were tabled. Chair suggested a letter ballot.
8. Chair's Report

Chair's Report

- Chair's Breakfast
 - TAC: online rostering. Very easy to do.
 - CEBD: Preliminary project list; we can review to see if there is any we are interested in
 - GTIC – Discussed ISO
 - RBC – Interested in finding residential topics for DLs
 - RAC – proposing changes to work statement development for RTARs
 - Online system deploying later this year
 - Trying to address issues of multiple rebids
 - More work up-front to generate an accurate cost estimate, identify and confirm potential bidders, and identify co-funders
- MTG proposed on Utilities & Decarb
 - TC 5.5 invited to participate.



Drake expanded on need for more people to step up and join the ISO effort

Liaison Reports [45 minutes total]

9. ASHRAE Learning Institute (Paul Pieper)

- As I continue to update **Air-to-Air Energy Recovery Applications: Fundamentals** and **Air-to-Air Energy Recovery Applications: Best Practices**, I will be reaching out to some of the members to get some updated images and information following this meeting
- Presented **Air-to-Air Energy Recovery Applications: Fundamentals** to MTA (Metropolitan Transportation Authority) Construction and Development on June 13, 2024, for fifty (50) people
 - Experience of the participants ranged from 1-3 years (Assistant Engineer) through several years of experience (remaining participants, which includes the Asst. Mechanical Engineers - some may have over 30 years of experience)



10. SSPC 90.1

a. SSPC 90.1 Activities –

90.1 Report

- Addendum h ASHRAE 90.1-2022: Site renewable exception
 - Correcting double dipping between exceptions and on-site renewable requirement in Section 10.5
 - Modify exception 3 in Section 6.5.6.1.2
 - Publish February 2024
- Addendum m ASHRAE 90.1-2022: Adding requirements in mandatory Section 6.4
 - Add 1060 requirement in Table 6.4.7 with exception for CSA-439
 - Published February 2024



90.1 Report

- Addendum p ASHRAE 90.1-2022: Limit Minimum Outdoor Air Rate to 130%
 - Voters and Commenter resolved
 - Publish May 2024
- Addendum y ASHRAE 90.1-2022: Change of requirements for non-transient building to include CSA-C439 rating
 - 45 Day Public Review from Feb 16 to April 1, 2024
 - 2 comments from 1 commenter, both rejected.
 - Not published yet



90.1 Report

- Addendum ag ASHRAE 90.1-2022: Series Energy Recovery Update
 - Clarification of definition and by removing the specific dry bulb condition at which it is rated
 - Approved for PPR (Publication Public Review) June 6th
- Addendum aj ASHRAE 90.1-2022: Indoor Pool Dehumidification Energy Recovery and Exhaust Air Energy Recovery
 - 50% sensible recovery minimum and moisture recovery is permitted for region 7 & 8
 - Does not transfer moisture to the outdoor airstream in the A and C climate zones.
 - Is capable of managing condensate from the exhaust air stream in the A and C climate zones.
 - Letter ballot for PPR



90.1 Report

- Addendum aa ASHRAE 90.1-2022: Emissions TPS
 - Change in Purpose and Scope of 90.1 to include requirement for that reduce greenhouse gas emission
 - Letter ballot for PPR (Publication Public Review)
- Addendum ai ASHRAE 90.1-2022: Net Zero Operational Energy Emissions Prescriptive and Performance Paths
 - No new requirements for ERV.
 - Removal of exceptions 3, 6 and 8
 - My understanding is to use renewable low carbon emissions energy with a building meeting 90.1 efficiency



90.1 Report

- Interpretation: Thermodynamic Energy Recovery Formal Interpretation
 - Adding definition and exception for Thermodynamic Energy Recovery
 - Basically, heat pump with a third coil in the exhaust air.
 - Committee request more data and industry performance test standard.
- Presentation and discussion topics:
 - Simplify Performance rating method for appendix G
 - Goal to make simpler, so more popular
 - Hospital HVAC turndown analysis by PNNL
 - Discussion about when it is good to have economizer and when not



90.1 Report

- ASHRAE 90.1 Work Plan for 2022 to 2031
 - 2019-2022 43% Energy cost saving compare 2004
 - 2028-2031 65% Energy cost saving compare 2004
 - Other metrics: Gross Energy Intensity, Carbon Emission & Energy used served by renewable resources energy

11. Standard 62.1 (Alkis)

Alkis is not in the meeting and we did not have a 62.1 report. We need to identify a new 62/1 liaison.

12. Standard 205 Working Group (Kristin Sullivan)

SSPC 205 Working Group – Kristin Sullivan

- Goal to share addendum for review by SSPC 205 at Indianapolis Orlando Meeting
- Remaining work includes:
 - Enumerate frost protection strategies (Moh Rafati)
 - Update equations to match current version of AHRI 1060
 - Check for consistency within addendum and with other addenda (Kristin Sullivan)



13. Technical Activities Council (TAC) Liaison Presentation (Kevin Marple) [30 minutes]

TAC – Kevin Marple

- New roster platform
- Strategic plan for technical activities
- Electronic Communications Committee is creating an electronic form platform



Subcommittee Reports [45 min total]

14. Handbook (G.D. Mathur)

TC 5.5 ASHRAE Handbook Sub Committee (January 23rd, 2024)

- Handbook SC Chair: P. Damshala, G.D. Mathur
- Liaison to 2024 ASHRAE Handbook Committee: Prakash Damshala
- SC members:
 - Prakash Damshala
 - Paul Pieper
 - Marcus D'Arcy
 - Mo Afshin
 - Mike Scofield
 - Jessica Dewitt
 - Charles-Antoine Caron
 - Alkis Triantafyllopoulos



ASHRAE 2024 Handbook – Systems & Equipment

Chapter 26 – Air-to-Air Energy Recovery Equipment

- Final Approved Chapter was submitted to ASHRAE on 7/28/23
- 2024 ASHRAE Handbook – HVAC Systems & Equipment:
 - Will be published in June 2024 (before Indianapolis meeting).
 - Or some of you should have received the new handbooks by now.
- Request to members: Please review the chapter 26 and provide feedback

This chapter will be published in 2024 ASHRAE Handbook in June 2024.



15. Program (Paul Pieper)

PROGRAM DISCUSSION AND UPDATES

The website is open for program submissions for the 2025 ASHRAE Winter Conference, and will remain open until **Friday, August 2** – you may submit through the link below: <https://ashraem.confex.com/ashraem/w25/cfp.cgi>

Tips for a good program submission:

- Make sure that you complete your submission. For Seminars and Workshops, you must submit 4 Learning Objectives and 10 question-and-answer sets for a complete submission.
- For program proposals with presentations (Seminars, Workshops, Panels), you must fill out a presentation abstract for each individual presentation before moving onto the next step. You can do this by clicking on the presentation title in Step 3: People.
 - Panels attach a “presentation” to each panelist – it is acceptable to title each as “Panelist 1”, “Panelist 2”, etc., and the presentation abstract can be the session abstract or a description of the panelist’s background with the subject. Note that actual PPT presentations are optional for Panel sessions.
- Non-Forum sessions should have at least 2 speakers – submissions with only 1 speaker are generally rated lowly.
- Programs should ideally have speakers from different affiliations; submissions with speakers from the same organization are usually discouraged.



PROGRAM POTENTIAL TOPICS

- FROST CONTROL – HOW DOES IT WORK AND HOW DO YOU MAXIMIZE PERFORMANCE
- USING AIR-TO-AIR TECHNOLOGY TO MEET YOUR DECARBONIZATION GOALS?
- HIGHLIGHT RECENT UPDATES TO STANDARD 84? – EXPAND ON NEW TECHNOLOGIES INTRODUCED?
- MURB DESIGNS AND STRATEGIES
- COMBINING ERV/HRV AND HEAT PUMP SYSTEMS



16. Research (Marc Tardif):

Research Report

- **TESTING AND MODELING OF HRV/ERV FROST CONTROL TECHNIQUES**

- This research will enhance existing frost control techniques and modeling capabilities of HRV and ERV systems in cold climates leading to an increase in the efficiency of ventilation systems in cold climates and aid in code compliance assessments. The main deliverable will be a research report and publications to document the performance of the various frost control techniques, the performance of existing algorithms, the development of a new or adapted algorithm, and the optimal control and system design of the various frost control techniques tested.

- **A guideline on proper control of frosting – this takes a Publication Topic Acceptance Request (PTAR) to get started, not an RTAR!**

- **Does ganging plate exchangers drive leakage differently from that of individual tested exchangers?**



Research Report

- **Some local codes do not allow certain types of defrost or frost prevention – why? Health impact?**
- **An RTAR to develop ERV 205 appendix**
- **What ERV technologies are not yet fully characterizable, by the usual metrics in Standard 84?**
- **Validate Guideline V as a system efficiency determination method?**
- **Research into effects of static pressure differentials (SP2 – SP3) on pressure drops and effectiveness. Could apply to plates and wheels. RTAR**
- **Effect of airflow distribution within the unit on effectiveness and pressure drop – RTAR Validation of test plenum guidance suggested by AHRI to ITS and members.**



17. Standards (Matthew Friedlander)

Standard 84 Method of Testing Air-to-Air Heat/Energy Exchangers

- This is the only Standard for which 5.5 is the cognizant Technical Committee.
- AHRI Standard 1060 refers to ASHRAE 84-2020 as the test method
 - 1060 is AHRI's certification program for ERV exchangers (components), and for ERV exchangers in packaged units (typically non-residential)



Standard 84 – Revision Cycle

- SC recommended at summer meeting 2023 to re-affirm the standard, because:
- The SC anticipated that new material will be available for revision in the next few years:
 - Simplified methods for testing of fixed-bed-regenerators (not yet ready)
 - Editorial changes recommended by ASHRAE staff (exists now)
 - Revision requires assembly of an SPC, meetings, etc, just to accomplish editorial changes
 - Affirmation requires no work by the TC
 - The standard can be recommended for revision whenever the simplified testing methods are available
- The TC voted unanimously at summer meeting 2023, to:
 - **Reaffirm**
 - Revise
 - Withdraw



Revision Public Review

- SRS issued a Revision Public Review in the October 20, 2023 Standards Actions bulletin. This did not indicate an intent to revise the standard beyond updating the references and bibliography.

- Changes:

- Added to the Foreword: →

- Updates Normative References ↓

The 2024 edition of Standard 84 updates references. This standard was prepared under the auspices of ASHRAE. It may be used, in whole or in part, by an association or government agency with due credit to ASHRAE. Adherence is strictly on a voluntary basis and merely in the interests of obtaining uniform standards throughout the industry.

12. NORMATIVE REFERENCES

1. ASME, 2013, ANSI/ASME PTC 19.1-2013, *Test Uncertainty*, New York: American Society of Mechanical Engineers. ²⁰¹⁸
2. ISO, 2017, ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*, Geneva, Switzerland: International Organization for Standardization. ²⁰¹⁸
3. ASHRAE, 2013, ANSI/ASHRAE Standard 41.1-2013, *Standard Method for Temperature Measurement*, Atlanta: ASHRAE. ²⁰¹⁸
4. ASHRAE, 2018, ANSI/ASHRAE Standard 41.2-2018 *Standard Methods for Air Velocity and Airflow Measurement*, Atlanta: ASHRAE. ²⁰¹⁸
5. ASHRAE, 2014, ANSI/ASHRAE Standard 41.3-2014, *Standard Method for Pressure Measurement*, Atlanta: ASHRAE. ²⁰¹⁸
6. ASHRAE, 2014, ANSI/ASHRAE Standard 41.6-2014, *Standard Methods for Humidity Measurement*, Atlanta: ASHRAE. ²⁰¹⁸
7. ASHRAE, 1992, ANSI/ASHRAE Standard 41.2-1987 (RA1992), *Standard Methods for Laboratory Air-Flow Measurement*, Atlanta: ASHRAE. ²⁰¹⁸
8. AMCA, 2018, ANSI/AMCA Standard 500-D, *Laboratory Methods of Testing Dampers for Rating*, Arlington Heights: Air Movement and Control Association. ²⁰¹⁸

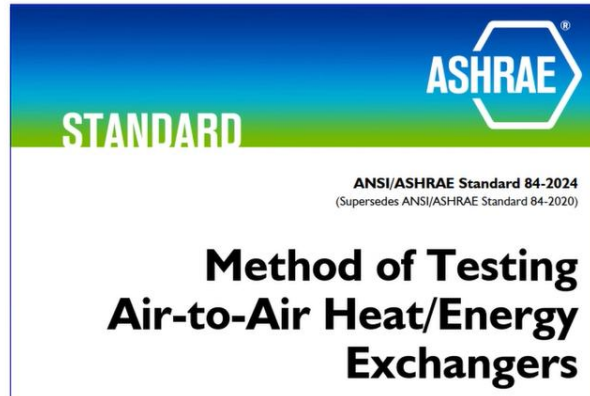
Duplicate

No comments
received



Standard 84-2024: published April 30, 2024

- Available in the bookstore
- NOT yet available in the free previews
- NOT available in Belarus and Russia!



Topics Identified for Future Exploration (1 of 2 slides)

Guideline on best practices for frost prevention or recovery

We believe the state of the art allows for a guideline to be written today (see RP 543, RP 544, ALI Courses and manufacturer recommendations).

→ SC recommended at Winter Meeting that the TC draft a Title, Purpose and Scope, and then form a GPC

Standard for characterization of operating conditions resulting in frost formation

There is considerable peer-reviewed literature on this topic, but an ASHRAE-sponsored research project might be necessary.

→ SC requests input from the TC



Topics Identified for Future Exploration (2 of 2 slides)

Guideline on Field testing

This section of 84 is not normative, we see this as a gap;
might need both lab experts and field-testing experts;
maybe large energy performance contractors are a source for expertise;
EN308 has some material; and they seek strengthen it.
→ SC requests input from the TC. Can TAC advise whether there is experience in field testing in other areas?

Pressure Drop Variation as a function of Static Pressure Differential

Does development of a metric serve market needs? Would such a metric belong in ASHRAE 84?
→ SC recommended at Winter meeting that TC request AHRI to determine if is something the market needs.
→ TC to make that request to AHRI representative at this meeting. Discussion as necessary.



C439-2018 under revision

- Basis of test used by HVI and NRCAN for whole-unit performance testing and rating
 - Testing and certification is functionally restricted to residential-size heat or energy recovery ventilating units.
 - The metrics are referenced by a number of codes and standards.
 - The standard includes the world's most stringent extreme cold weather testing.
- The 2018 version included significant changes and errors
 - An HVI member working group reviewed the standard deeply and issued detailed recommendations for changes to the standards, primarily corrections and clarifications.
- New version went to public review last month
 - Resolution of public comments is likely
 - NRCAN has additional comments
 - New version is intended to be consistent with test methods compliant with C439-2018 and its errata and interpretations.



RP 1780 Test Method To Evaluate Cross-contamination Of Gaseous Contaminants Within Total Energy Recovery Wheels

Sponsored by TC 9.10 Laboratory Ventilation
Published June 2023

EXECUTIVE SUMMARY

The main goal of ASHRAE RP-1780 was to develop a test method to evaluate gaseous contaminant transfer in total energy recovery wheels...

Does any TC 5.5 member have any update or comment on this Report?



Global Standards with Similar Scope

- ISO 21773:2021
 - Patterned on ASHRAE 84, method of laboratory test for exchangers (not ventilators)
- ISO 16494-1: 2022 Second edition
 - Method of laboratory test for complete ventilators with heat/energy recovery
 - Minor updates and clarification published 2022-06-14
 - 16494-2:2019 Guidance on uncertainty analysis



Global Standards with Similar Scope (cont.)

- EN308:2022 Heat exchangers — Test procedures for establishing performance of air to air heat recovery components
 - Method of test for exchangers (not industrial heat recovery):
 - in labs
 - in units
 - in the field
 - Structured for use in the European system of Energy Performance of Building Directive
 - Partially aligned with ASHRAE 84 and ISO 21773
 - Requires tracer gas tests for all wheels, and for plates when static leakage test result is >3%
- 2022 edition used in Eurovent certification of Air Handling Units
- 1997 edition used in Eurovent certification of
 - Air To Air Plate And Tube Heat Exchangers
 - Air To Air Regenerative Heat Exchangers
 - Heat Recovery Systems With Intermediate Heat Transfer Medium



EN308 next steps

- Last meeting April 24 2024
 - Convenor role passes from Heinrich Huber to Simone Dugaria, also of Lucerne University
 - It is proposed that EN308 be transferred from TC110 Heat Exchangers to TC156 Ventilation for Buildings. Rationale: standard is predominantly used for exchangers in building ventilation systems.
 - New work implementation proposal:
 - provide a method of test for run around loop and coil systems (without phase change)
 - Provide a method of test for systems using heat pumps for energy recovery
 - Test casing influence
 - Measurement uncertainties



ISO-5222 Parts 1, 2 and 3

- Part 1: Sensible heating recovery seasonal performance factors of HRV
- Part 2: Sensible cooling recovery seasonal performance factors of HRV
- Part 3: Annual sensible heating and cooling recovery performance factor of HRV

Seeks to use HRV unit tests per ISO 16494 at one heating and one cooling operating condition.

Results of tests are used to populate bin models of psychrometric conditions for various climates.

Can incorporate bypass for free cooling and preheat for defrost.

Result: "seasonal performance factor" the ratio of annual sensible energy recovered plus power value of moving air, divided by annual electrical power input to unit



ISO Standards in Progress (cont.)

- DIS 5222-1, Part 1: Sensible heating recovery seasonal performance factors of HRV 40.20
 - Requires some modification of terms to harmonize with Parts 2 and 3.
 - Re-registered 4/23/2024 with required completion date of 10/22/2025
- NP ISO 5222-2, Part 2: Sensible cooling recovery seasonal performance factors of HRV
 - DIS approved for registration as FDIS 11/29/2023
 - FDIS must be submitted for publication by 6/30/2023
- 5222-3, Part 3: Annual sensible heating and cooling recovery performance factor of HRV
 - DIS approved for registration as FDIS 6/9/2024
 - FDIS must be submitted for publication by 12/1/2024



- Load-based, Climate-specific Testing & Rating Procedure for Commercial Heat Recovery & Energy Recovery Ventilators (HRV & ERV)
- Seeks to generate annual performance metrics
- Financially supported by Canadian utilities
- Public Review closed June 25, 2024
- Requires four to six physical tests, each at three airflows, similar but not identical to tests in C439
- Final output includes Seasonable Coefficient of Performance
 - Can be segmented into heating and cooling, occupied and unoccupied



BSR/ASHRAE Standard 227P, Passive Building Design Standard

Revised TPS approved June 22, 2021.

PURPOSE: This standard provides requirements for the design of buildings that have exceptionally low energy usage and that are durable, resilient, comfortable, and healthy.

Structured around passive house principals of high insulation levels, low thermal bridging, ventilation with energy recovery.

227P is aiming to release a PPR fairly soon, they might vote to release it at the meeting.



Energy Recovery Ventilation in 227P

- ERV MEPs are proposed in this standard, which is intended for adoption in codes or incentive programs.
- Ratings from AHRI 1060, HVI, PHI, [Eurovent](#) and other certification programs will be used to show compliance with the MEPs.
- Ratings of the same product under different programs may not be equivalent.
- SPC 227P needs specific responses to the PPR to correct any disparities between defined metrics and the rated values.
- Members are alerted to pay attention to the PPR;
- A WG could be formed to perform technical analysis of the differences between the referenced standards to determine the equivalent metrics and biases between them;
- I'm not clear whether the TC is able to file a public review comment);
- TC5.5 could appoint a liaison to 227P.



We voted to have Matthew Friedlander as liaison to 227P. Paul Piper proposed and Drake was the second. No objections or abstentions

18. Website <http://tc0505.ashraetcs.org/> (Brandon Damas)

19. Membership (Chair)

Membership

- Membership discussion
 - Need a membership chair?
 - Focused YEA recruiting



New Business

None

Next Meeting

Next face-to-face meetings will be at the 2025 Annual Meeting, January 2025, in Orlando, FL

- Kristin Sullivan, Chair TC 5.5
25 June 2024

Exhibit 1:

ASHRAE Code Of Ethics

(Approved by ASHRAE Board of Directors January 30, 2013)

1.140.001.1 As members of ASHRAE or participants in ASHRAE committees, we pledge to act with honesty, fairness, courtesy, competence, integrity and respect for others in our conduct.

A. Efforts of the Society, its members, and its bodies shall be directed at all times to enhancing the public health, safety and welfare.

B. Members and organized bodies of the Society shall be good stewards of the world's resources including energy, natural, human and financial resources.

C. Our products and services shall be offered only in areas where our competence and expertise can satisfy the public need.

D. We shall act with care and competence in all activities, using and developing up-to-date knowledge and skills.

E. We shall avoid real or perceived conflicts of interest whenever possible, and disclose them to affected parties when they do exist.

F. The confidentiality of business affairs, proprietary information, intellectual property, procedures, and restricted Society discussions and materials shall be respected.

G. Each member is expected and encouraged to be committed to the code of ethics of his or her own professional or trade association in their nation and area of work.

H. Activities crossing national and cultural boundaries shall respect the ethical codes of the seat of the principal activity.

Exhibit 2: Voting Members and Officers as of 5/24/2024 (does not reflect changes effective July 1, 2024)

Full Name	Company	Position	Start Date	End Date
Ms Kristin Rice Sullivan	Trane Technologies	Chair	07/01/2023	06/30/2025
Mr John Bade	2050 Partners	Secretary	07/01/2023	
Dr Gursaran D Mathur, PE	Highly Marelli North America	Hndbk Subcom Chair	07/01/2020	
Mr Marc Tardif	Innogytech Inc	Program Subcom Chair	07/01/2023	
Mr John T Dieckmann	TIAX LLC	Resrch Subcom Chair	07/01/2022	
Mr Brandon Damas	Texas AirSystems	Webmaster	07/01/2019	
Mr Paul L Pieper, Eng, PE	The Master Group	ALI Coordinator	07/01/2022	06/30/2026
Mr Marcus D'Arcy	Desert Aire	Member	07/01/2022	06/30/2026

Mr Drake H Erbe	Airxchange Inc	Member	07/01/2022	06/30/2026
Matthew Friedlander	Renewaire LLC	Member	07/01/2022	06/30/2026
Dr Mohammad Rafati		Member	07/01/2021	06/30/2025
Mr Triantafyllos Andreas Triantafyllopoulos		Member	07/01/2022	06/30/2026