



ASHRAE Meeting Agenda

TC 9.6 Health Care Facilities

Chicago Hybrid Annual Meeting

Main Meeting: Sunday, Jan 21, 2024, 5:00 to 7:00 PM CST

Location, McCormick Place West, W184bc (1)

(Mead, Chair; Eldridge, Vice-Chair; Granzow; Secretary)

Virtual: Webex link available at TC 9.6 webpage:

<https://tpc.ashrae.org/?cmtKey=4ec4bea4-fa45-464f-9bb0-d79b6edc372d>

Or you may participate via phone:

+14702385742 US Toll

Access code: 2334 508 9744

SUBCOMMITTEE MEETINGS will be held in person AND virtually on Sunday Jan 21 at the times indicated below.

Location: McCormick Place West, W184bc (1)

Virtual instructions: Please see MS Teams link and information below on the virtual portion of our meeting. The same link is being used for all subcommittee meetings.

<https://events.rdmobile.com/Asset/Download/f9d50caa-6673-4427-af91-b1705a9a7a57>

Meeting ID: Meeting ID: 288 517 753 607

Passcode: caVHyS

Virtual attendees can also click "Enter Meeting" under the "Resources" tab in the conference schedule listing to join the meeting(s) on the noted date and time.

Or call in (audio only)

+1 513-458-7170,,142911798# United States, Cincinnati

(888) 994-4478,,142911798# United States (Toll-free)

Phone Conference ID: 142 911 798#

TC 9.6 Infectious Diseases	(Neu, Chair)	2:00-3:30 pm CST
TC 9.6 Research*	(Thomsen, Chair)	3:30-4:30 pm CST

* Being held jointly with SSPC 170 Research Subcommittee

TC 9.6 Handbook	(English, Chair)	12:00-12:30 pm CST
TC 9.6 Energy	(Leach, Chair)	12:30-1:30 pm CST
TC 9.6 Program	(Granzow, Chair)	1:30-2:00 pm CST

ASHRAE Code of Ethics Commitment

In this and all other ASHRAE meetings, we will act with honesty, fairness, courtesy, competence, integrity and respect for others, and we shall avoid all real or perceived conflicts of interest. (See full Code of Ethics: <https://www.ashrae.org/about/governance/code-of-ethics>)

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.

Attendance: Please document your attendance using the link below. You only need to do this one time for main TC meeting as well as all subcommittees you are also attending:

<https://form.jotform.com/231753647820156>

Item	Description	Person	Time (min)
1	<p>Introductions, agenda, conference call and attendance documentation instructions</p> <ul style="list-style-type: none"> • 72 total in attendance <ul style="list-style-type: none"> ○ 24 Virtual ○ 48 In person 	Mead	5
2	<p>Roll call, quorum check.</p> <p><u>Mead, Kenneth</u> X</p> <p><u>Granzow, Frederich</u> X</p> <p><u>Thomsen, David</u> X</p> <p><u>Bhansali, Amit</u> X</p> <p><u>Burley, Brendon</u> X</p> <p><u>English, Travis</u> X</p> <p><u>Kondrat, Paul</u> X</p> <p><u>Mousavi, Ehsan</u></p> <p><u>Phelps, Erick</u> X</p> <p><u>Wilson, Laurence</u> X</p> <p><u>Lemire, Nicolas</u> X</p>	Granzow	2
3	<p>Minutes</p> <ul style="list-style-type: none"> • Assembling and will be posted to basecamp 	Granzow/Eldridge	5
4	<p>Membership Chair Report, Roster Changes, Welcome PCM's</p> <ul style="list-style-type: none"> • Refer to attached presentation • As of Friday <ul style="list-style-type: none"> ○ 247 overall members ○ 12 Voting members ○ 127 Corresponding members ○ 108 Provisional Corresponding Members ○ 39 YEA members 	Westbrook	5
5	<p>Chair's Report TAC Breakfast Meeting</p> <ul style="list-style-type: none"> • New Section 9 head – Joy Altweis • New TC for Environments in Space • New Roster form will be online – Beta testing right now 	Mead	3

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	<ul style="list-style-type: none"> Looking for ways to get more Fellows 54k members. 1k TC members. Very little overlap between chapter meetings and TCs. 		
7	<p>Handbook Subcommittee Report</p> <ul style="list-style-type: none"> Just starting Reach out to Travis with topics for updates See attached subcommittee minutes 	English	5
8	<p>Energy Subcommittee Report</p> <ul style="list-style-type: none"> Regrouping with new TPS Discussed potential topics for committee work Discussed ways to be more internationally focused in lieu of just North America. See attached subcommittee minutes 	Leach	5
9	<p>Programs Subcommittee Report</p> <ul style="list-style-type: none"> Review of current programs at this meeting Review of presentations people are working on for future meetings Looking for new subcommittee chair See attached subcommittee minutes 	Granzow	5
10	<p>Infectious Diseases Subcommittee Report</p> <ul style="list-style-type: none"> New chair ETF handoff process was discussed In the news Disease X – How can the committee move forward Can ASHRAE Gov Outreach help reach out to WHO regarding 241? See attached subcommittee minutes 	Neu	5
11	<p>Research Subcommittee Report</p> <ul style="list-style-type: none"> Recap of active and potential projects See attached subcommittee minutes 	Thomsen	5
12	<p>Webmaster Report</p> <ul style="list-style-type: none"> Website up to date Working on meeting minutes 	Augustini	3
13	<p>Section Head Comments</p> <ul style="list-style-type: none"> See chair breakfast notes 	Cochran	5

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14	<p>ALI</p> <ul style="list-style-type: none"> Last class was 3 hrs and was too short Revised class is done and scheduled new sessions. Added new content on electrification and decarbonization 	Burrough	3
15	<p>Liaison Reports</p> <p>-Std 241</p> <ul style="list-style-type: none"> Published last summer Now an SSPC Working on some CMPs Looking for pilot candidates <p>-Std. 170</p> <ul style="list-style-type: none"> Meeting tomorrow and Tuesday Addendum m will be out for public review soon regarding room recirc units Publishing first quarter of 2025, working to finalize several addenda <p>-Std. 189.3</p> <ul style="list-style-type: none"> Working on electrification addendum Working on low flow plumbing fixture issues <p>-Std. 188</p> <ul style="list-style-type: none"> Tyler Anderson reported that SSPC 188, 514 and Guideline 12 are working to combine committees. 514 has been published since Tampa <p>-Std 90.1</p> <ul style="list-style-type: none"> Nobody present <p>-Std 55</p> <ul style="list-style-type: none"> Brenden Burley reported that standard was just published and the committee met to brainstorm topics for next round of revision <p>-Std 62</p> <ul style="list-style-type: none"> Several updates. Density corrections now required New adhoc workgroup looking at equivalent clean air for IAQ Staying with seal class A vs leakage standard Looking at model laws regarding instant air quality reporting and looking to get data on IAQ <p>-Environmental Health</p> <ul style="list-style-type: none"> Kem Mead reported 	<p>Flannery</p> <p>Fauber</p> <p>Vernon</p> <p>Darwich</p> <p>Poots</p> <p>Burley</p> <p>Taylor</p>	<p>2</p> <p>2</p> <p>2</p> <p>-</p> <p>2</p> <p>2</p> <p>2</p> <p>2</p>

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	<ul style="list-style-type: none"> • Meets tomorrow morning • Looking at briefs and possible retirements <p>-ACH MTG</p> <ul style="list-style-type: none"> • CO-RP8 – actively seeking bidders <p>Scott Fielder reported on standard 111 Testing Adjusting and Balancing and 7.7 involvement regarding support of 9.6 research</p>	Lautz	2
16	<p>Healthcare Decarbonization Guide (ASHRAE/ASHE collaboration)</p> <ul style="list-style-type: none"> • Has been turned into publications • Looking at only new buildings • Coordinated with REHEVA guide to avoid conflicts • Looking at hospitals only • ~100 pages • Focuses on Scopes 1, 2 and 3 from the GHG protocol • Document is not duplicative letting other guides cover deep dives on specific topics • Looks at storage and thermal offsets for short and long term • Looks at microgrids • Did not include baseline models • Did not include decarb codes 	Walt Vernon	5
17	<p>Special Presentation & Discussion: Update to ASHRAE/RHEVA Guides focusing on energy and decarbonization</p> <ul style="list-style-type: none"> • Update on guidebook status • Working to wrap up some examples and updates per current legislation, the ASHRAE MTG, and COVID results. • Hoping to publish by Jan 2025, faster if possible • ~50 page guidebook • Will passive house hospital in Frankfurt Germany be in the book? 	Mills/Maassen	15
18	<p>Vice-Chair Remarks</p> <ul style="list-style-type: none"> • Sign in reminder • TC dinner at Victory Tap 	Eldridge	2
19	<p>Closing Remarks</p> <ul style="list-style-type: none"> • Asked all non-voting members or people with conflicts of interest to leave the room for a private session 	Mead	2

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20	Executive Session <ul style="list-style-type: none">● PES chair reported on TRP-1864● Vote to approve recommendation<ul style="list-style-type: none">○ Paul K○ Ken M○ Eric G○ David T○ Larry W○ Amit B○ Erick P○ Nicolas L○ 8/0/0/3	Mead	
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TC 9.6 Membership

January 21, 2024

- 247 overall members
 - 12 Voting members
 - 127 Corresponding members
- 108 Provisional Corresponding Members
 - 39 YEA members

Executive team

TC Officers (Through June 30, 2025)

- TC Chair: Ken Mead
- Vice Chair: David Eldridge
- Secretary: Erik Granzow

Roster changes
2024 Society year

Voting members, terms expiring June 30, 2024

Amit Bhansali

New Voting Members effective July 1, 2024

George Augustini

Jennifer Leach

Gina Semerad

Voting Members 2024 Society year

Amit Bhansali (2024)
Ehsan Mousavi (2025)
Lawrence Wilson (2025)
Erik Granzow (2026)
Ken Mead (2026)
Erick Phelps (2026)
Steve Friedman (2026)
Brendan Burley (2027)
David Thomsen (2027)
Travis English (2027)
Paul Kondrat (2027)
Nicolas Lemire (Member-Non Quorum)

Subcommittee chair and officers 2023-2025 Society term

- Handbook (Applications, Chap. 8): Travis English
 - Research: David Thomsen
 - Standards: Jeremy Fauber
 - Programs: Erik Granzow
 - Membership: Ron Westbrook
- Healthcare Energy subcommittee: Jennifer Leach
 - Infectious Diseases subcommittee: Dylan Neu
 - Webmaster: George Augustini
 - ALI Coordinator: Don Burroughs
- TC associated MTG (MTG-ACR, Air exchange rates): Roger Lautz

TC 9.6 Handbook Subcommittee Meeting (2023 Applications – Health Care Facilities)

Sunday, Feb 5, 2023

12:00 pm – 12:30 pm (EDT).

Item	Description	Person	Time
1	Welcome	T. English	1
2	Introductions and Sign-in Link:	All	1
3	Updates	P. Likhonin	3
4	New Business - brainstorming	T. English	2

Intro:

Updates:

1. Things to do for 2027 version:
 - a. Word count reduction - page count is blown up
 - b. Perhaps move to design manual (note 1)
2. If it's in 170, just leave it in 170
3. Infectious aerosols, coordination with 241 and related chapters from other handbooks
4. Errata from the 2023 version
5. Outstanding comments in 2023 spreadsheets
 - a. Mike Meteyer notes on follow up conversations
 - b. Don Burroughs is leading the design manual effort, in start up
6. Encourage anyone to have seminars, write papers; it's easier to cite into the chapter.

Notes

- A. The design manual is re-starting. It is just in the process of restarting. Lead is Don Burroughs
dburroughs@dewberry.com
- B. Heather Kennedy is the contact at ASHRAE. We need to add the 2023 chapter into 2027 folder in author's portal.

(Pavel has contact info)

Meeting Adjourned 12:25pm

ASHRAE TC9.6 HEALTHCARE FACILITIES

Energy Subcommittee

MEETING SUMMARY

January 21, 2024, 12:30-1:30pm CST
McCormick Place West, Room 184bc
Chicago, IL

AGENDA:

1. Energy subcommittee - purpose and scope?
2. Future resources, publications

ATTENDEES:

Jen Leach, Sub-com Chair
Jotform.com

NOTES:

- 1) Purpose and Scope
 - a) *Title: TC9.6 Healthcare Facilities*
 - i) *Purpose: ?*
 - ii) *Scope: TC 9.6 is concerned with the application of ventilating, air-conditioning, refrigeration, life safety, and energy conservation systems to healthcare (hospital, outpatient, long-term care) facilities.*
 - b) Title: Energy Sub-committee
 - i) Purpose/Scope: To provide access to and the creation of resources for reducing the energy consumption and GHG emissions related to the operation of Healthcare facilities, while minimizing negative impacts on the planet and not compromising occupant safety, health and wellbeing.
- 2) Priorities for the subcommittee moving forward.
 - a) Update occupant, plug and process load profiles.
 - b) Top Five/Ten areas of focus for energy savings and carbon reduction.
 - i) Design
 - ii) Operations & Maintenance
 - c) Add data resources to the TC website and the online Applications Handbook.
 - d) North American focus. How do we increase our focus more internationally?
 - i) Natural ventilation.
 - ii) Reach out to other chapters/organizations to write a comparison of hospital design. Challenges, differences in regulations.



TC 9.6 Healthcare Facilities – Programs Subcommittee

Sunday 01/21/2024, Hybrid

- I. Introductions
- II. TC 9.6 Sponsored Programs/Courses at 2024 Winter Meeting (0)
- III. Other Programs/Courses of Interest at 2024 Winter Meeting (4)

Panel 8: Impacts of Standard 241 on ASHRAE's Existing Ventilation Standards

Tuesday, January 23
8:00 AM – 9:30 AM CST

Program Level: Intermediate Program Track: Ventilation, Indoor Air Quality and Air Distribution Systems Session Type: Panel
Location: Marriott Marquis Chicago, Great Lakes B Show 1 more tag

Summary:

Speakers familiar with Standards 62.1, 62.2, and 170 will discuss their experiences with implementing Standard 241. The presentations will focus on how Standard 241 has changed the way they design and operate ventilation systems and any challenges they have encountered with implementing Standard 241. The audience will be encouraged to share their own experiences and receive feedback from the panel.

Chair:

Brendon Burley, Healthcare Practice Leader

Other Sponsoring Committee:

EHC, SSPC 62.1, SSPC170

Location: Marriott Marquis Chicago, 2nd Floor, Great Lakes B

ASHRAE Standard 241: Energy Implications of Different Strategies to Meet Equivalent Clean Air Requirements for Commercial and Educational Spaces (CH-24-C080)

Tuesday, January 23
11:00 AM – 11:20 AM CST

ASHRAE Standard 241: Energy Implications of Different Strategies to Meet Equivalent Clean Air Requirements for Commercial and Educational Spaces (CH-24-C080)

Presenting Author: Marwa Zaatari, PhD, D Zine Partners, Austin, TX, USA

In summer of 2023, ASHRAE published Standard 241, the first ever airborne infection risk mitigation standard for buildings, bringing numerous benefits to occupants and promoting healthier environments. One of the key breakthroughs of the standard is establishing requirements for a metric in terms of equivalent clean airflow rate in units of flow per occupant in a space (ECAI) and targets for 25 different space types that range from 30 to 90 cfm/person. Achieving ECAI target can be done using one or multiple strategies such as outdoor air, air filtration and disinfection that are demonstrated to be safe and effective. Different strategies have different contribution to ECAI and different impacts on energy consumption and carbon emission. We considered outdoor air rates using ASHRAE Standard 62.1 prescriptive (Ventilation Rate Procedure) and performance-based approach (Indoor Air Quality Procedure), energy recovery ventilation, mechanical filtration (MERV 7, 11, and 13), in-room air cleaners, and UVGI disinfection for commercial and educational facilities in 15 different ASHRAE climate zones. We repeated the analysis to explore the impact of high outdoor air pollution events such as wildfire on the proposed strategies. Although wildfire smoke contains multiple contaminants, this analysis focuses on controlling exposure to PM_{2.5}. For each scenario, we used the equivalent clean air calculator spreadsheet provided by the Standard to calculate ECAI and we used large-scale simulation of prototypical building energy models to calculate the resulting energy consumption of different combination of strategies. Then, we calculated the \$/ECA to rank the different strategies. Keeping outside air to a minimum and using a combination of air filtration and disinfection proved to be the less energy intensive strategy in most climate zones to meet the required ECAI. This is also true in wildfire events where outside air need to be minimized while keeping a positive pressure in the space and using high MERV filters to clean recirculated air.

Learning Objectives:

- Understand the implications of implementing different ventilation and air cleaning strategies to achieve the required clean air rates as mandated by ASHRAE Standard 241.
- Learn about the impact of different strategies on energy consumption, costs, and carbon emissions in both the infection risk management mode (IRMM) of ASHRAE Standard 241 and the wildfire smoke mode (WFSM).

Location: Marriott Marquis Chicago, 2nd Floor, Great Lakes F

Optimizing the Use of Room Air Purifiers in Combination with HVAC Filters for IAQ and Energy Efficiency (CH-24-C083)

Tuesday, January 23
12:00 PM – 12:20 PM CST

Optimizing the Use of Room Air Purifiers In Combination with HVAC Filters for IAQ and Energy Efficiency (CH-24-C083)

Presenting Author: Ramin Rezaei, Agentis Air LLC, Derwood, MD, USA

Author: Larry Rothenberg, J.D., Agentis Air LLC, Rockville, MD, USA

Author: Alan Viosca, Agentis Air LLC, rockville, MD, USA

his study explores the relationship between room air purifiers and HVAC filters in terms of both IAQ and energy use. The goal is to optimize IAQ while minimizing energy use. The study determines this relationship at a variety of particulate levels, with fine and ultra fine particles, a variety of HVAC operating conditions (i.e. air circulation rates and MERV ratings), and a variety of CADR levels for the subject room air purifiers

Learning Objectives:

- Describing the state of the art behind Electrostatic Filter and how they perform
- Explaining how electrostatic filters can be more effective and at the same time Save More Energy vs Mechanical Filters

Location: Marriott Marquis Chicago, 2nd Floor, Great Lakes F

Paper Session 2: Simultaneously Increasing Indoor Air Quality and Decarbonizing Commercial Buildings

Sunday, January 21
8:00 AM – 9:00 AM CST

Program Track: Decarbonization and Climate Change

Session Type: Paper Session

Location: Marriott Marquis Chicago, Great Lakes G

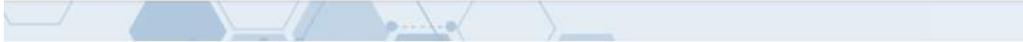
Summary:

Traditionally, increasing indoor air quality is perceived to entail greater energy use. This session presents new technologies that can provide clean and healthy air and promote decarbonization.

Chair:

Daniel Villa, PE

Location: Marriott Marquis Chicago, 2nd Floor, Great Lakes G



Sub-sessions

The Paradox between Decarbonization and Indoor Air Quality and Using Technology to Solve the Dilemma (CH-24-C003)

Decarbonizing Buildings with High-Performance Dedicated Outdoor Air Systems (CH-24-C004)

Evaluating the Performance of a Solar Air Heating System for Preheating Building Ventilation Air (CH-24-C005)

IV. Indianapolis, IN 2024 Winter Meeting, June 22 – June 26, 2024

Overview of Conference Tracks:



1. Fundamentals are the foundation for understanding applications in engineering. Key components of ASHRAE fundamentals include thermodynamics, psychrometrics, fluid flow and heat and mass transfer. This track provides opportunities for papers and presentations of varying levels across a large topic base. Concepts, design elements and shared experiences for theoretical and applied concepts of HVAC&R design are included.

Track Chair: **Atilla Biyikoglu** | abiyyik@gazi.edu.tr



2. HVAC&R Systems and Equipment are constantly evolving to address the changing requirements of the built environment. Papers and programs in this track focus on the development of new systems and equipment, novel applications of existing systems and equipment, improvements to existing systems and equipment and the proper application and operation of systems and equipment.

Track Chair: **Ng Yong Kong** | nyk@nyk.com.my



3. Active research, and the exchange of those research findings, are critical to the development of our HVAC&R industry and built environment. The 11th Annual Research Summit invites researchers to share those results, including ASHRAE-sponsored research and research of interest to the ASHRAE community. Researchers are invited to present papers, extended abstracts, seminars, forums or participate in panel discussions. The Research Summit includes a partnership with ASHRAE's archival journal, *Science and Technology for the Built Environment*.

Track Chair: **Kristin Cetin** | cetinkri@msu.edu



4. As members of a professional organization, we participate not only for the great value of technical exchange, but also the interpersonal exchange. We recognize that the single greatest strength of our organization is its membership. This track is designed to allow those professionals an opportunity to develop in the areas of presentation skills, leadership, team building, understanding various business operations, interpersonal skills, etc. The Professional Development Track covers all aspects of business outside of engineering/technical applications and lends itself to interactive session types such as workshops and forums.

Track Chair: **Ahmed Abdelsalam** | ahmed.abdel-salam@usask.ca



5. Global legislative efforts are pushing for full electrification of the building sector. This track features programs that explore the required technology to meet legislative targets and the seen and unforeseen challenges and consequences of rapidly electrifying the built environment in parallel with other sectors. Submissions are encouraged in the areas of relationships between electrification and decarbonization, electrification of space and water heating, building/grid interactions in a highly electrified environment, onsite energy generation and storage, district energy systems and all other areas related to the electrification of building systems.

Track Chair: **Kevin Brown** | kevin@kbsquared.net



6. Artificial Intelligence and Machine Learning have the potential to transform how we design, optimize and operate buildings and equipment. From the automated design of heat exchangers to adaptive controls to the development of new working fluids, the possibilities are vast. This track highlights papers, case studies, and programs that separate the hype from reality and explore the possibilities of AI and ML tools for advancing technology for the built environment.

Track Chair: Vinod Venugopal | vinodpvgopal@gmail.com



7. The explosion of computational capacity and data collection capability is rapidly expanding the scope, complexity, and practical applications of modeling and performance characterization both during design, construction, end-of-life, but even more so for fault detection, diagnostics, and operational optimization. These data can provide better insights on the whole life cycle impact of building construction and operation on efficiency and decarbonization goals. This track welcomes programs related to all aspects of building life cycle assessment, with a particular interest in successful applications that have extended modeling into operational phases of the building life cycle.

Track Chair: Money Khanna | khannamoney@gmail.com



8. Legislation such as the US Inflation Reduction Act (IRA) of 2022 and global F-Gas regulations can dramatically impact the building sector by incentivizing different technologies and approaches to managing building energy systems. In addition, ASHRAE is well known for its standards and design guidelines and their continuous evolution to improve the built environment and its systems in terms of IEQ, resource efficiency and energy consumption. ASHRAE members must be able to keep up with the rapidly evolving legislative environment and prepare to inform future legislation, standards and codes. The programs in this track highlight recent changes and opportunities to inform new legislation, standards and guidelines and their impact on the buildings sector.

Track Chair: Cindy Callaway | cindy.callaway@p2sinc.com

Indianapolis Dates:

- ~~Wednesday, November 29, 2023~~ | CP Abstracts, and Paper Session Requests Due
- ~~Wednesday, December 13, 2023~~ | Conference Paper Abstract Accept/Reject Notifications
- ~~Friday, January 5, 2024~~ | Website Opens for Extended Abstracts and Seminar, Workshop, Forum, Debate and Panel Proposals
- **Monday, February 26, 2024** | Debate, Panel, Seminar, Forum, Workshop, and Debate Proposals Due
- **Friday, March 15, 2024** | Extended Abstract Paper Due
- **Friday, March 15, 2024** | Full Conference Papers Due; Request for Conference Paper Sessions Due
- **Monday, April 1, 2024** | Conference Paper Accept/Revise/Reject Notifications
- **Monday, April 1, 2024** | Extended Abstract Accept/Reject Notifications
- **Wednesday, April 10, 2024** | Revised Conference Papers Due
- **Friday, April 12, 2024** | Debate, Panel, Seminar, Forum, Workshop Scheduling Notifications
- **Wednesday, April 24, 2024** | Conference Paper Final Accept/Reject Notifications

V. Future Meetings

- Indianapolis, IN: 2024 Annual Meeting, June 22 – June 26
- Orlando, FL: 2025 Winter Meeting, Feb. 8 – Feb. 12
- Phoenix, AZ: 2025 Annual Meeting, June 21 – June 25
- Las Vegas, NV: 2026 Winter Meeting, Jan. 31 – Feb. 4
- Austin, TX: 2026 Annual Meeting, June 27 – July 1

VI. Discussion on Potential Program Topics

- Resources for future meetings:
<https://www.ashrae.org/conferences/conference-resources/papers-and-programs>
- From Winter Meeting 2022:
 - Decarbonization
 - Walt Vernon is leading the MTG on Decarbonization and volunteered to help.
 - From Summer Meeting 2022
 - Benchmarking Data
 - A presentation from David Eldridge regarding the benchmarking data their group has collected.
 - Operations and Maintenance of Healthcare Facilities
 - Partner with TC 7.9 in commissioning.
 - Presentation on important factors/considerations regarding maintenance and operations of HC facilities.
 - Amit Bhansali volunteered a potential speaker regarding the commissioning aspects.
 - EUI at design for normal operation vs emergency operation
 - Does emergency operations effect hospital EUI?
 - Dave Thompson, David Eldridge and Walt Vernon have data showing no real increase.
- From Winter Meeting 2023
 - Epidemic Task Force Results suggested by Jen Leach
 - From Energy Subcommittee Meeting
 - Energy Modeling Input Profiles Base On Existing Measured Data
 - Unoccupied Setback Controls
 - Canada vs USA Benchmarking Data
 - Adiabatic Humidification (Ben Russell)
 - Geothermal Hospital Lessons Learned
- From Summer Meeting 2023
 - Planned presentations for Chicago
 - Paper session on the research project recently completed by Ehsan and Roger CO-P3.
 - Panel Discussion on Geothermal Systems at Healthcare Facilities.
 - Not accepted
 - EUI Data presentation by David Eldridge.
 - 241 as applied in hospitals seminar by ?? Maybe Travis

- Planned presentations for Indianapolis
 - Paper Session on data and results of monitoring by Kurt.
- From Chicago
 - Renewable energy in healthcare – Leach
 - Microgrids
 - Storage – Thermal and Power
 - Grid interaction – NEC
 - Walt – Decarb guide presentation
 - Global challenges
 - North America vs other regions
 - SPD Changes/Challenges
 - AAMI Standard on Water Quality
 - ASHRAE Standard 514/188
 - Clean/Dirty Pressurization

VII. Subcommittee Membership

- Searching for a new chair



ASHRAE Meeting Agenda
TC 9.6 Infectious Disease Subcommittee
Chicago Hybrid Annual Meeting
Sunday, Jan 21, 2024, 2:00 to 3:30 PM CST 2:05-2:54
Location, McCormick Place West, W184bc (1)

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Passcode: caVHyS

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I. Introductions:

- Sign-in (<https://form.jotform.com/231753647820156>)
- **60 in person attendees, ~25 online**

II. Subcommittee Business

- New Chair – Dylan Neu from CDC/NIOSH
- ETF 9.6 handoff update?
 - i. **Stalled since 241, but not stopped, Bill Bahnfleth is finalizing report for this meeting**
- Update on 241 – Flannery
 - i. Implementation and feedback
 1. **A few places implementing, nothing official yet**
 - ii. Future changes
 1. **3 CMPs, no healthcare specific yet**
 - iii. Open discussion

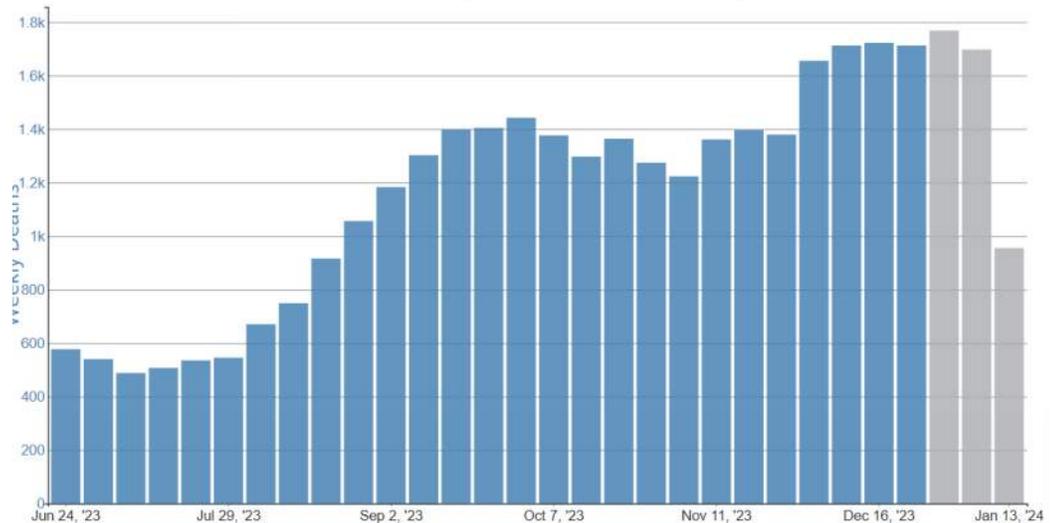
Attendance: Please document your attendance using the link below. You only need to do this one time for main TC meeting as well as all subcommittees you are also attending:

<https://form.jotform.com/231753647820156>

III. ID in the News

- Mpox
 - i. There has been a large increase in Clade I MPXV infections in DRC, with signs of sexual transmission which has not been seen before
 - ii. Clade II MPXV infections continue to be seen in the US
 - iii. New MMWR report on wastewater surveillance shows very high probability of seeing cases in wastewater (>70% for a single case in the water treatment area) [Detecting Mpox Cases Through Wastewater Surveillance — United States, August 2022–May 2023 | MMWR \(cdc.gov\)](#)
- Measles
 - i. Outbreak in Philadelphia
 1. 8 cases identified in unvaccinated individuals ([Health Dept Update: Philadelphia Measles Outbreak - Outbreak News Today](#))
- COVID
 - i. COVID deaths remain elevated after the winter holidays at around 1,700/week in the US

Provisional COVID-19 Deaths, by Week, in The United States, Reported to CDC



- ii. Lots of stories in the news around Long COVID as we shift away from pandemic mode, particularly on a new study showing potential mechanisms [Long Covid study reveals major insights on a potential cause \(nbcnews.com\)](#)
- Flu/RSV
 - i. Some experts agree that we are returning to a more normal respiratory virus seasonality, with flu data in particular showing a return to pre-pandemic patterns [Respiratory viruses appear to be falling back into seasonal order \(statnews.com\)](#)
- “Disease X”
 - i. [WHO director calls for world pandemic treaty to prepare for Disease X \(yahoo.com\)](#)
- Open table for sharing

Attendance: Please document your attendance using the link below. You only need to do this one time for main TC meeting as well as all subcommittees you are also attending:
<https://form.jotform.com/231753647820156>

- i. Perhaps we could have a subgroup in ID for preparing for unknown diseases
 - 1. Chat versus in person discussion can be helpful to bring other voices to the table
- ii. Sizing of oxygen systems for future pandemics as example of things we need to look at
- iii. Time to publish a white paper? What happens if we lose the information the website. Can be hard to find. If we publish a lessons learned book/paper for facilities
 - 1. ETF published something? Friedman reviewed the FGI guidelines publication
 - 2. Larry: capture feedback from facility owners since COVID. They have a “COVID hangover”. Focus any publication on an owner side since they stopped listening to COVID info. The attitude seems to have become “we got through it, so we can do it again” without preparing further
- iv. ETF debriefed ASHRAE on what worked and what could be better. Connections are so important as they help people come together quickly, so continuing participation in ASHRAE meetings and conferences is highly encouraged
- v. Medical gas resiliency document published last year by Army Corps of Engineers. This is an example of the standards that can help us move forward for future pandemics.
- vi. ASHE Feb 2021 compiled a document called “Current...” that compiles lessons learned from COVID
- vii. TC Chair’s meeting this morning included news that 6 additional subcommittees in 9.6 would be authorized and treated as a true subcommittee

IV. Guest from EPA:

- Update from US EPA – Dr. Katherine Ratliff
 - i. New DoD study for 24-hour Continuously operated spaces
 - ii. EPA vs FDA regulations
 - 1. FDA only regulates those devices that make disease transmission or in patient care settings, EPA regulates organism kill claims and in not patient care spaces. There is lots of nuance on who regulates what and where.
 - 2. EPA accepts complaints about false or misleading claims on disinfection and pesticide products.
 - 3. UK NHS standards for air cleaners published Feb ’23. All air cleaners are tested in a central facility if they want to sell to NHS, UV and HEPA only.
 - iii. Open discussion
 - 1. Isolation standard from NHS Positively pressurized anteroom HBN-04 supplement 1

V. Suggestions for future topics/presentations?

Attendance: Please document your attendance using the link below. You only need to do this one time for main TC meeting as well as all subcommittees you are also attending:

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- Emerging technologies?
 - i. DNA tracers
 - ii. Far-UV?

Attendance: Please document your attendance using the link below. You only need to do this one time for main TC meeting as well as all subcommittees you are also attending:
<https://form.jotform.com/231753647820156>

TC9.6 / 170 Research Subcommittee Report

- Subcommittee met January 21, 130pm PT
- Highlights –
 - One published sponsored/co-sponsored research project
 - Two ongoing sponsored/co-sponsored research projects
 - Three sponsored/co-sponsor work statements bids being reviewed
 - Two sponsored/co-sponsored work statements underway
 - Zero sponsored/co-sponsored RTAR or PTAR in development
 - Four potential sponsored RTAR in development

Research

- TC9.6 Co-sponsor - 1780 RP: Test method to evaluate cross-contamination of gaseous contaminant within total energy recovery wheels.
 - Brendon: Published, presentation Tuesday
- TC9.6 Sponsor - RP-1816: Reporting the Energy Use and Heat Gain from Imaging Equipment
 - Oscar: Underway, coordinating with hospitals and manufacturers to complete data acquisition
- TC9.6 Co-sponsor with TC2.9 – RP-1854: Database of Ultraviolet Inactivation Rate Constants (k-values) for Microorganisms Critical to System Design
 - Ken/Dylan: Progressing, literature review complete, extended through August 2025

Research

- TC9.6 Sponsor - 1889 TRP: Graywater use in Healthcare Facilities; determining risk and appropriate design responses
 - Eric/Erica/Tyler: Bids being reviewed
- TC9.6 Co-sponsor with TC2.9 - 1873 TRP: UVGI Design Applications for Large Volume Spaces
 - Ken/Dylan: Placed on hold, other ASHRAE efforts may have eliminated research need
- TC9.6 Sponsor - 1864 TRP: Investigating the applicability of Standard 62.1's Ventilation Rate Procedure for Healthcare Rooms
 - Ken: Preliminary vendor selection complete
- TC9.6 Co-sponsor with TC2.9 – 1928 WS: Air Cleaner Efficiency in Combination Chamber Duct System
 - Ken: Preliminary vendor selection complete

Research Development - WS

- TC9.6 Co-sponsor with ACR MTG – CO-RP-8 (formerly 1936): Air Change Rate Impact on Ventilation Effectiveness
 - Kishor: Price Industries agreed to co-fund, development underway, looking for potential bidders
- TC9.6 Co-sponsor with TC2.1 – 1931 WS: Determination of the Metabolic Rates and CO₂ and Aerosol Generation of Occupants in Modern Offices, Medical Settings, and Commercial Kitchens
 - Mike (now Sierra): Underway, trying to finalize by March
- TC9.6 Sponsor - 1955 WS: Anteroom ventilation rate, temperature range, pressure relationship, and boundary conditions
 - Ted/Ehsan/Erick: RAC approved with comments, team addressing comments, hoping to complete efforts by March

Research Development – RTAR and PTAR

- None – need to replenish!

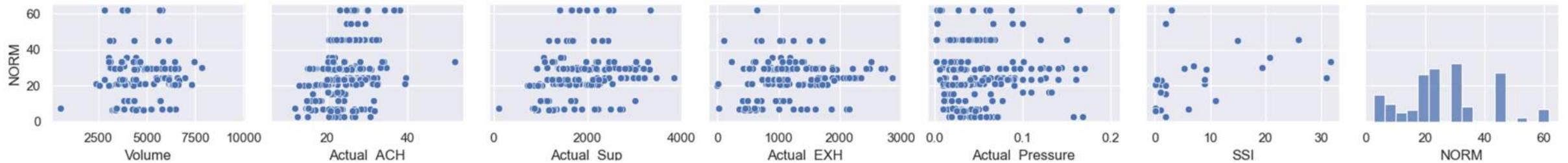
Research Development – Potential RTAR

- XXXX RTAR: Understanding the appropriate application of humidity and temperature control strategies across climate zones on infectious aerosol transmission
 - Jonathan/Alejandro/Duncan/Traci/Brendon: Awaiting 170 workgroup, likely Summer 2024
- XXXX RTAR: Patient bathroom ventilation design
 - Ken/Travis/Larry: Rough draft of RTAR started
- XXXX RTAR: Risks Associated with different medical practices (clinic, MOB, hospital)
 - Jeremy/Sonia: Good discussion
- XXXX RTAR: Ventilated Headboard
 - Roger?

Thanks

Research Development - Other

- Big Data Operating Room Air Change Analysis
 - Ehsan/Kevin/Fred: CO-RP3 breakout. Utilize primarily public SSI data and TAB reports. Preliminary results presented June 2023.
 - 400 operating rooms, 29 hospitals, 3 states
 - Next steps – conclude Pilot phase, soliciting funding



ASHRAE-REHVA Guidebook Towards Zero Energy Hospital Buildings

Wim Maassen
January 21st 2024

ASHRAE TC 9.6 meeting



Rijksdienst voor Ondernemend
Nederland

Stichting
Promotie
Installatietechniek
(PIT)



Status

- All ASHRAE and REHVA reviewer comments were addressed beginning 2020.
- Permissions need to be completed for case studies and for pictures/tables.
- Lay-out needed to be adjusted to format ASHRAE

Updates

1. Include reference to Covid works such as the ASHRAE Covid material. Include references that offer energy efficiency such as UVC air cleaning which allows recirculation in places where it is currently not allowed – such as Europe.
2. Refer to ASHRAE Decarbonisation task force and published material. Note Decarbonisation guide for hospitals (which Walt Vernon's group is doing for ASHRAE).
3. Refer to proposed ASHRAE Decarbonised hospital guidance work. Including possible NZC guide for hospitals
4. Check case studies are still relevant and update or amend if necessary

Updates

5. Refer to recently published and publicly available material such as the UK NHS Net Zero Carbon Standard and related material.
6. Note that HTM 07 is about to be updated – this is known as Encode and covers energy usage/efficiency.
7. Note that the NHS are about to start a programme of training for Decarbonisation across all hospitals in England/UK.
8. Include new legislation e.g.: EU – Energy Performance Directive IV, EU – Taxonomy
9. Include Roadmap studies NL for Hospital Buildings achieving Net Zero in 2050

Planning

- Jan 2024 => TC 9.6 to review and approve new scope at Chicago meeting in Jan 2024.
- Jan => draft updates, list of required permissions and list of case studies
- Feb-March => finalize content
- Apr-May => finalize lay-out and permissions
- Jun => submit GB to reviewers or for vote
- Jun => formal vote TC 9.6
- Sept 2024 => address comments finalize GB
- Oct 2024 => submit GB to ASHRAE Publication
- Jan 2025 => Publication of Guidebook => ASHRAE Winter Conference

Background and content of Guidebook

Next step (ASHRAE-)REHVA(-TVVL) Guidebook



Targeting 100!

Envisioning the High Performance Hospital: Implications for a New, Low Energy, High Performance Prototype

Full Report

University of Washington's Integrated Design Lab

with support from

Northwest Energy Efficiency Alliance's (NEEA) BetterBricks Initiative

Heather Burpee
Joel Loveland

in collaboration with

NBBJ Architects
Solarc Architecture and En
TBD Consultants
Cameron MacAllister
Malkum Architects
Mortenson Construction

The Environment of Care and Health Care-Associated Infections

An Engineering Perspective

HVAC Design Manual for Hospitals and Clinics

Second Edition

ASHRAE

NREL
NATIONAL RENEWABLE ENERGY LABORATORY



Healthcare Energy End-Use Monitoring

Michael Sheppy, Shanti Pless, and Feitau Ku
National Renewable Energy Laboratory

NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency & Renewable Energy Operated by the Alliance for Sustainable Energy, LLC. This report is available at no cost from the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications.

Technical Report
NREL/TP-5600-...

Guidebook: Additional and referring to available more detailed publications

MISSION
:
Net Zero

ASi



tion of
ean Heating,
tion and
nditioning
iations

WHAT?

- ashrae rehva guidebook nzeb hospital buildings
- 50 pages
- 50% practice / evidence
- reference is made to other guidebooks on detailed engineering
- focus on approach, method, risk management and quantification benefits (not only cost reduction but improvement of primary process)

Realizing a positive attitude to CO2 emissions reduction in hospitals and creating "can do" mind set using a pragmatic approach, method, measures and evidence to realize CO2 emission reduction in new Hospital Buildings.

Considering future hospital operation and challenging the standards and design requirements.

Providing academic evidence and real examples.

positive attitude
pragmatic approach

"can do" mindset

*future hospital operation
challenging the standards*

academic evidence

real examples.

Questions to be answered

- where do we stand with NZE hospital building design ?
- what approach and methods can be used to realize NZE hospital ?
- what requirements and standards are in place and need to be challenged ?
- what are major opportunities ?
- what are key research/development topics ?
- what examples indicate the relevance of this (effective hospital building design)
- Don'ts! No gas?

Taskforce and reviewers

REHVA TRC Taskforce

- Wim Maassen – TVVL
- Frank Mills - CIBSE
- Jarek Kurnitski – EKVU
- Hans Besselink – TVVL

REHVA TRC Reviewers

- Livio Mazzarella – AiCARR
- Hywel Davies – CIBSE
- Jaap Hogeling – TVVL

ASHRAE TC 9.6 Taskforce

- David Eldridge
- Travis English
- Maya Salabasheva
- Heather Burpee
- Frank Mills
- Wim Maassen

ASHRAE TC 9.6 Reviewers

- David Schurk
- Paul Ninomura
- Amit Bhansali

Authors

- Travis English - Kaiser Permanente (US) - Author
- Maya Salabasheva - Kaiser Permanente (US) - Author
- Heather Burpee - University of Washington (US) - Author
- Kishor Khankari - AnSight LLC (US) - Author
- Frank Mills - Low Carbon Design Consultants (UK) – Chief Editor 2/Author
- Wim Zeiler – TU/e (NL) – Author
- Walt Vernon – Mazzetti + GBA (US) - Author
- Birol Kilkis, Baskent University (TR) - Author
- Wim Maassen – Royal HaskoningDHV, TU/e (NL) – Chief Editor 1/Author

Seminar 'Ziekenhuizen op weg naar energieneutraal!'

📅 vrijdag 30 november 2018 van 14:00 uur tot 19:00 uur

📍 [OWC Erasmus MC](#)

📍 Bijeenkomst, Landelijk, Derden

Programma

- | | |
|-----------|---|
| 14.00 uur | Ontvangst met koffie en thee |
| 14.30 uur | Welkom door Marije Hulshof en Erasmus Medisch Centrum |
| 14.35 uur | 'Duurzaamheid en energieconcepten in het Erasmus MC/Nieuwbouw' door Arjan Windhorst |
| 15.05 uur | 'Ziekenhuizen: Wakker worden! De BENG-eisen komen eraan' door Wim Maassen |
| 15.35 uur | Pauze |
| 15.50 uur | 'Towards net-zero hospitals in the UK' by Frank Mills |
| 16.20 uur | 'The hope and possibility of net-zero hospitals in the US regulatory context' by Travis English |
| 16.50 uur | Forum discussion (Arjan, Frank, Travis, Wim) |
| 17.10 uur | Netwerkborrel |
| 17.45 uur | <i>(onder voorbehoud) Rondleiding nieuwbouw Erasmus MC</i> |

Do No Harm



Seminar: Towards Energy Neutral Hospital Buildings! 120 participants, 10 different Hospitals

<https://www.linkedin.com/feed/update/urn:li:activity:6476363043440717824>

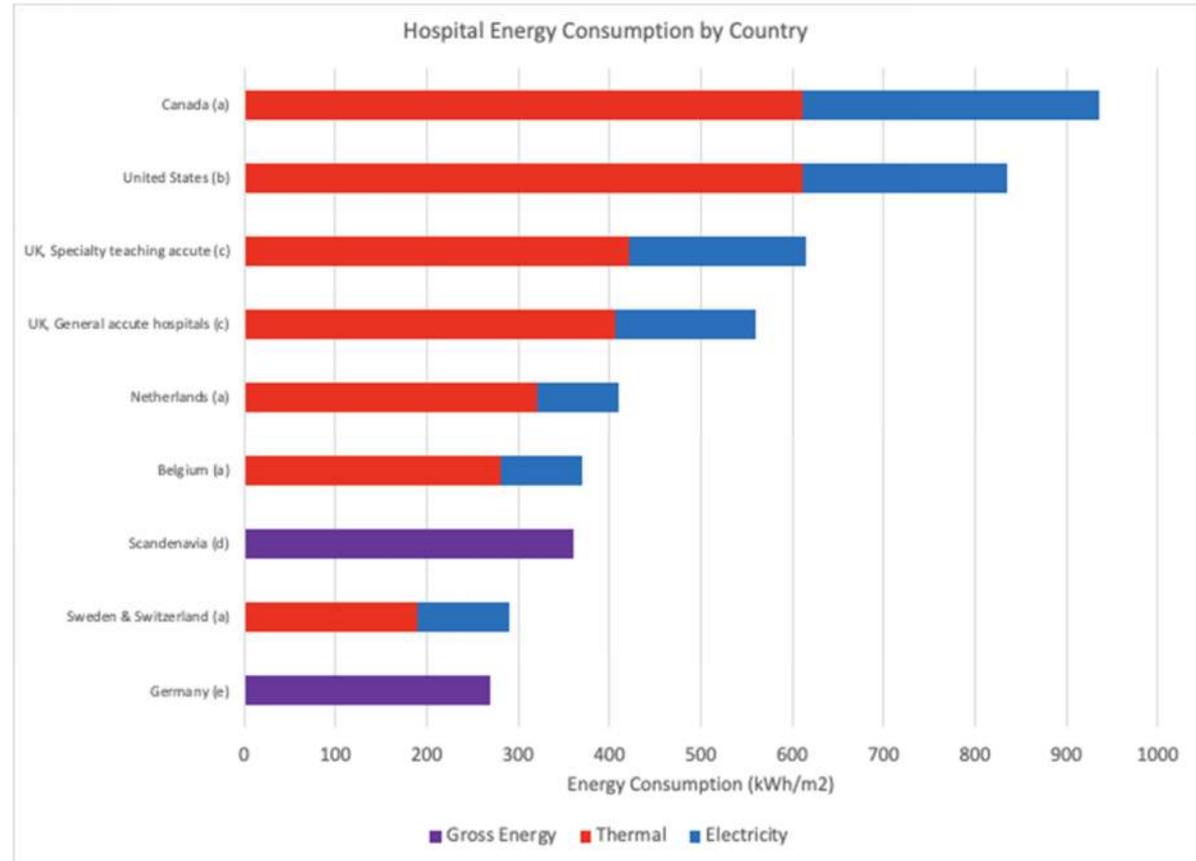


Content Guidebook

- Preface – Why Hospitals? Why Now?
 - Introduction
 - Approach
 - Design solutions
 - Commissioning
 - Hospitals Moving Towards 2050
 - Conclusions and Recommendations\
 - References
-
- Appendix I – Energy Measurements and Definitions
 - Appendix II – Case Studies
 - Appendix III – Theoretical case

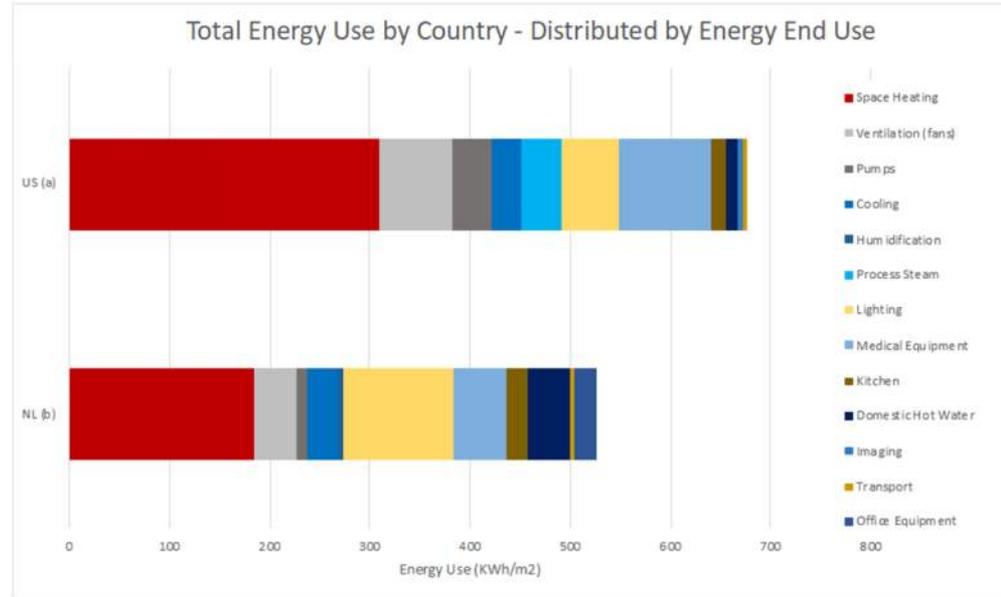
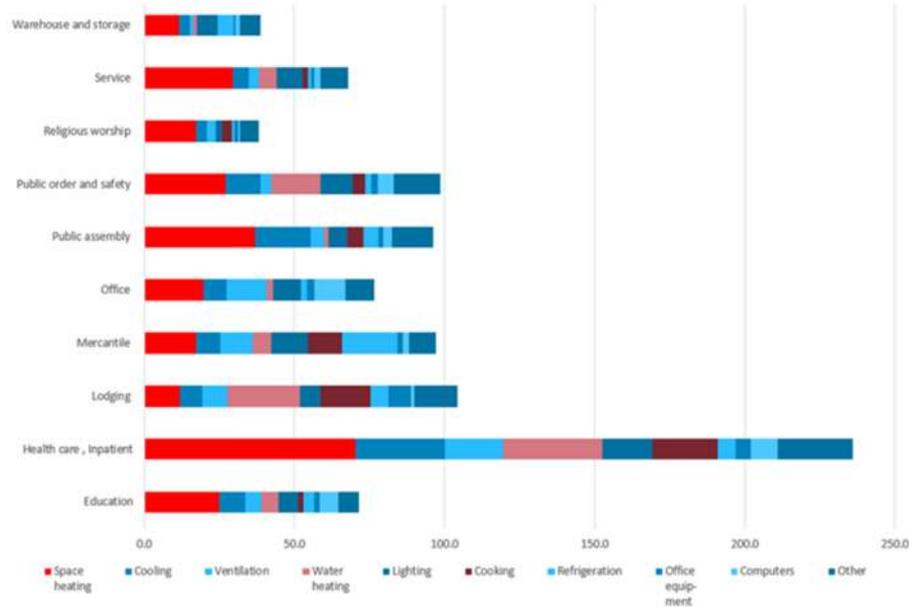
Content Guidebook

■ Introduction



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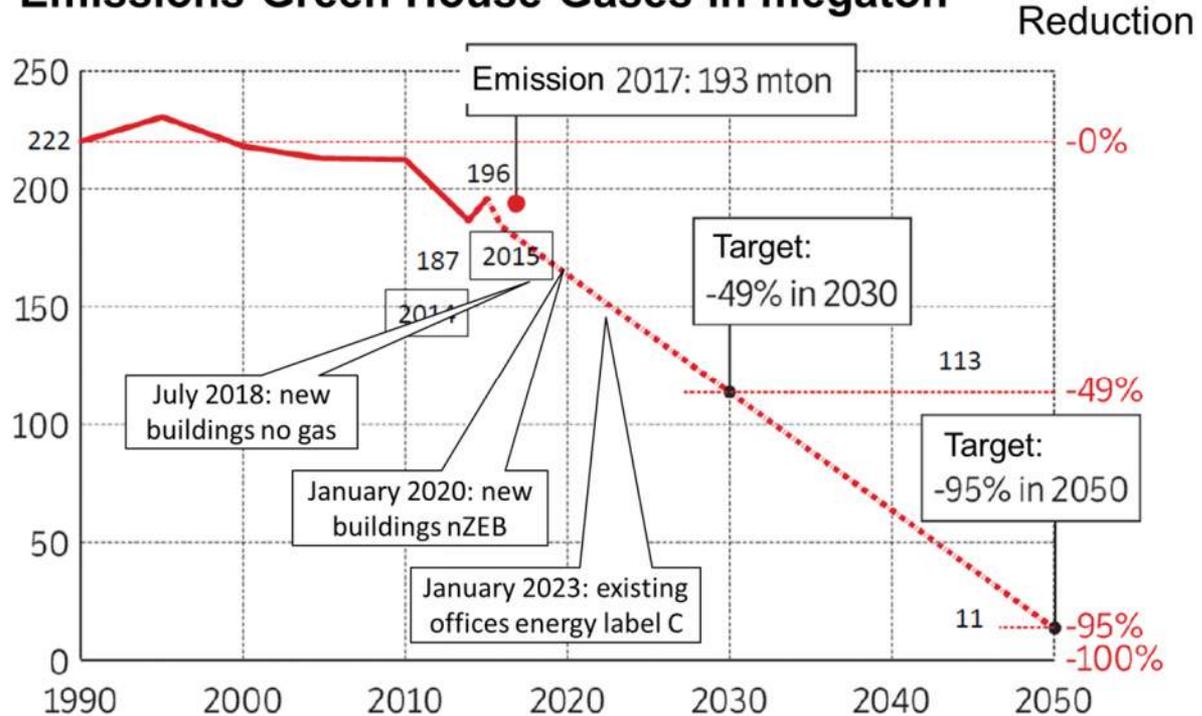
■ Introduction



Content Guidebook

■ Introduction

Emissions Green House Gases in megaton

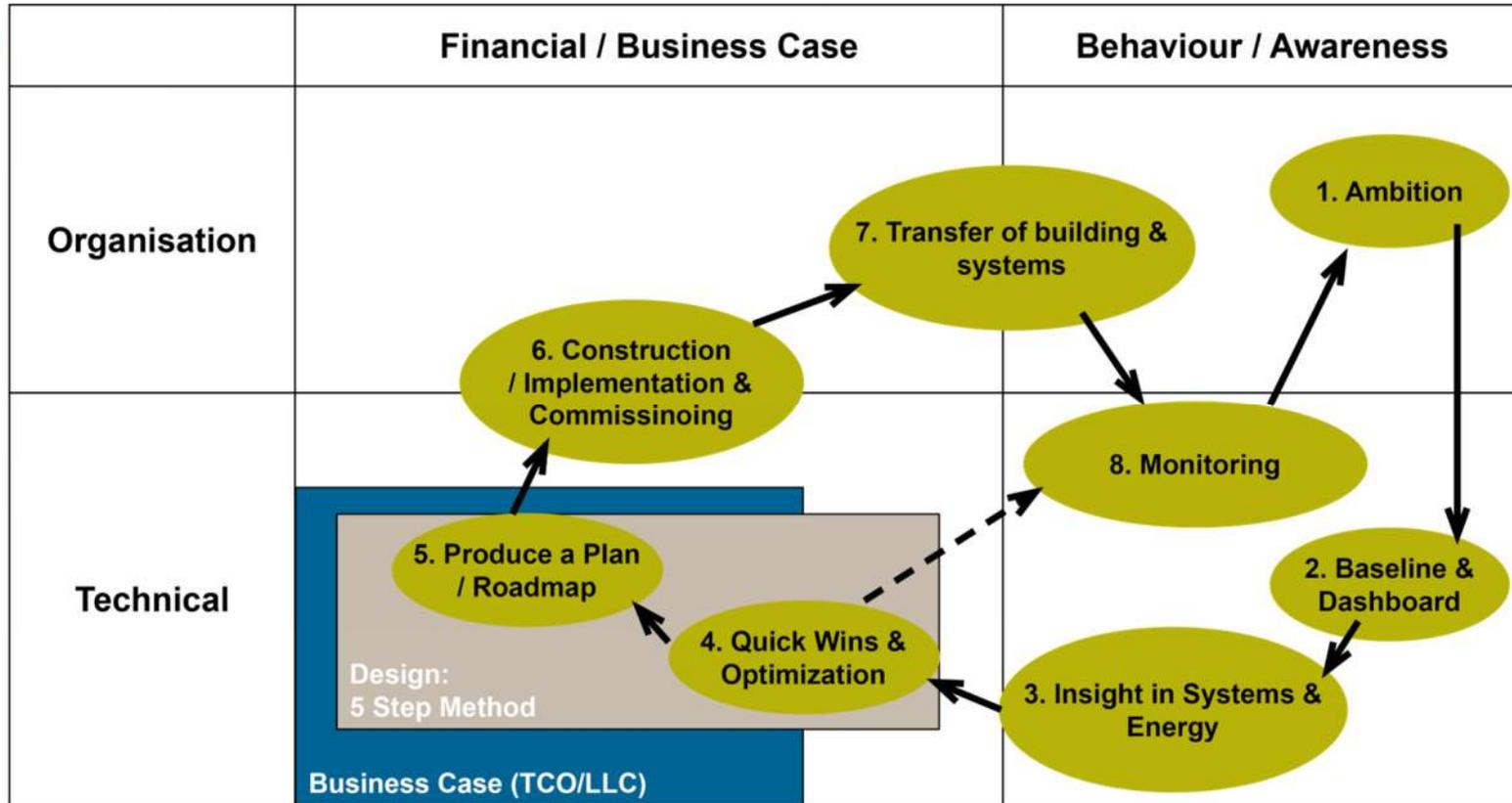


NRC 170918 / EvG / Bron: PBL, CBS

[presented by David Smeulders, TVVL Techniekdag 2018]

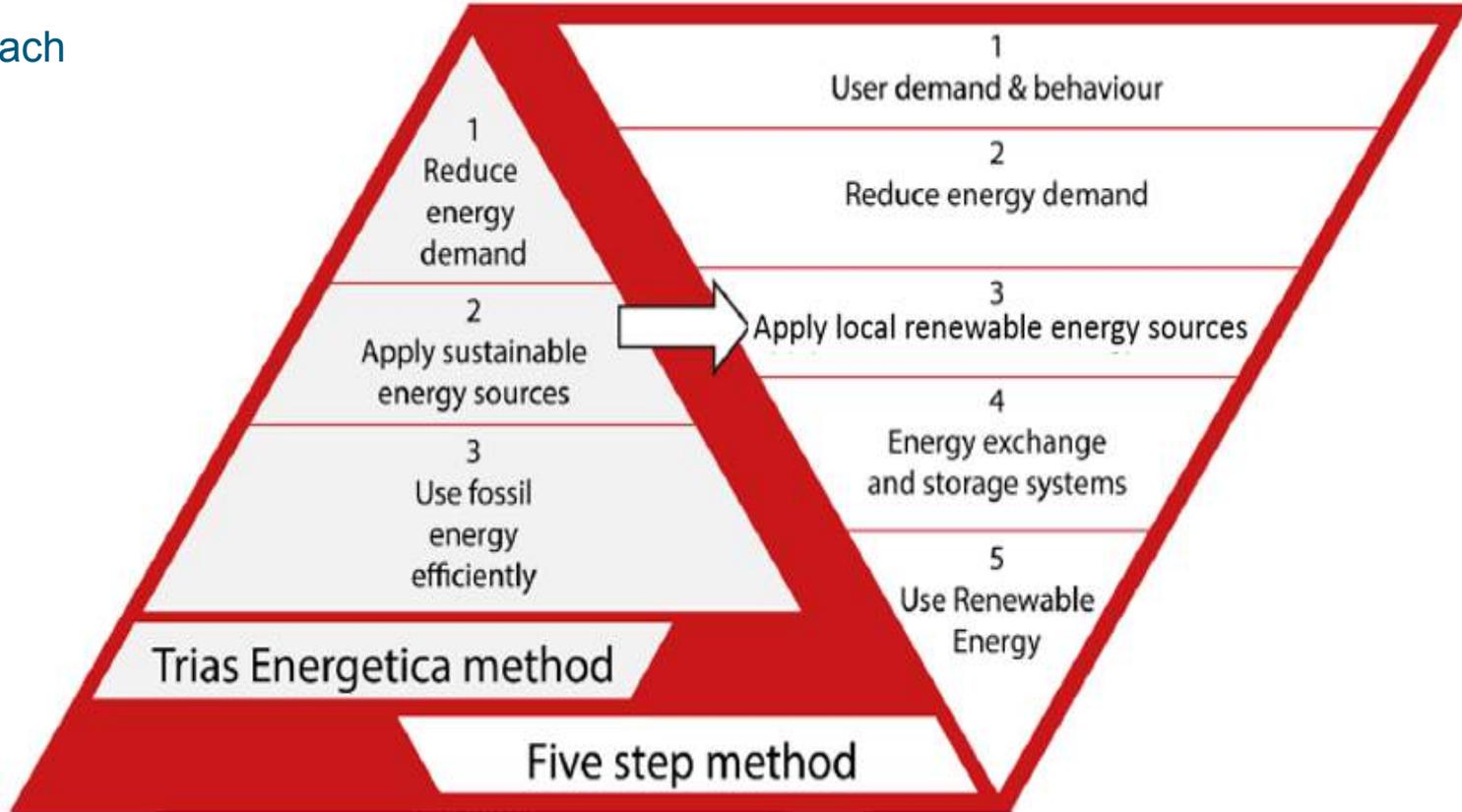
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■ Approach



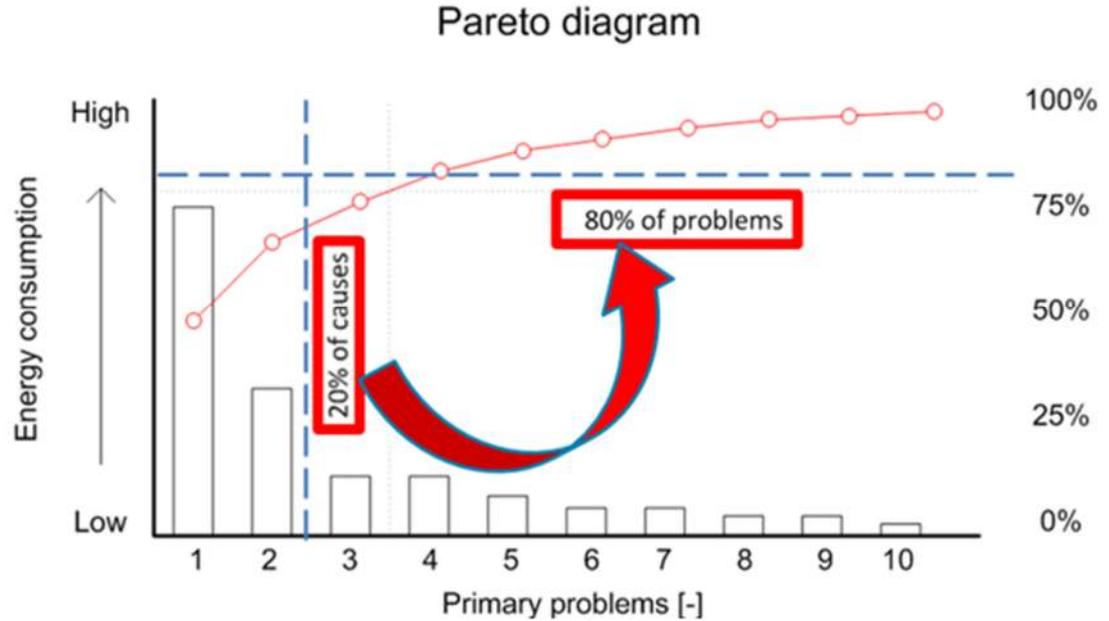
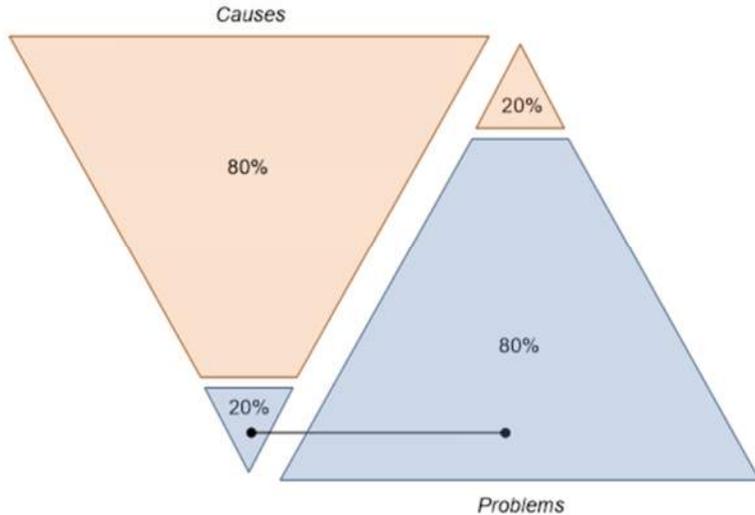
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■ Approach



Content Guidebook

■ Approach



Content Guidebook

■ Design solutions

ACR

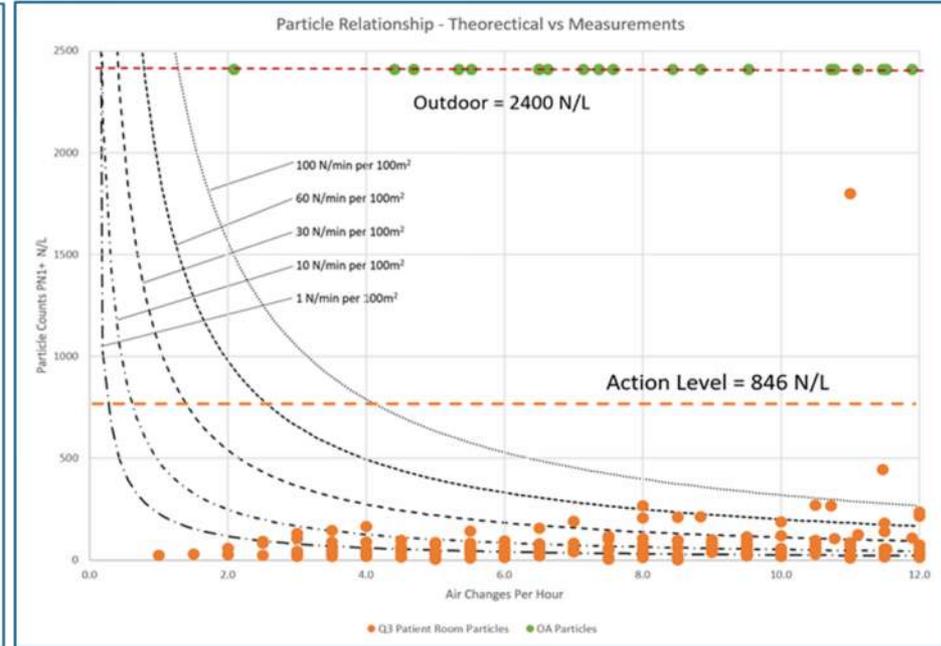
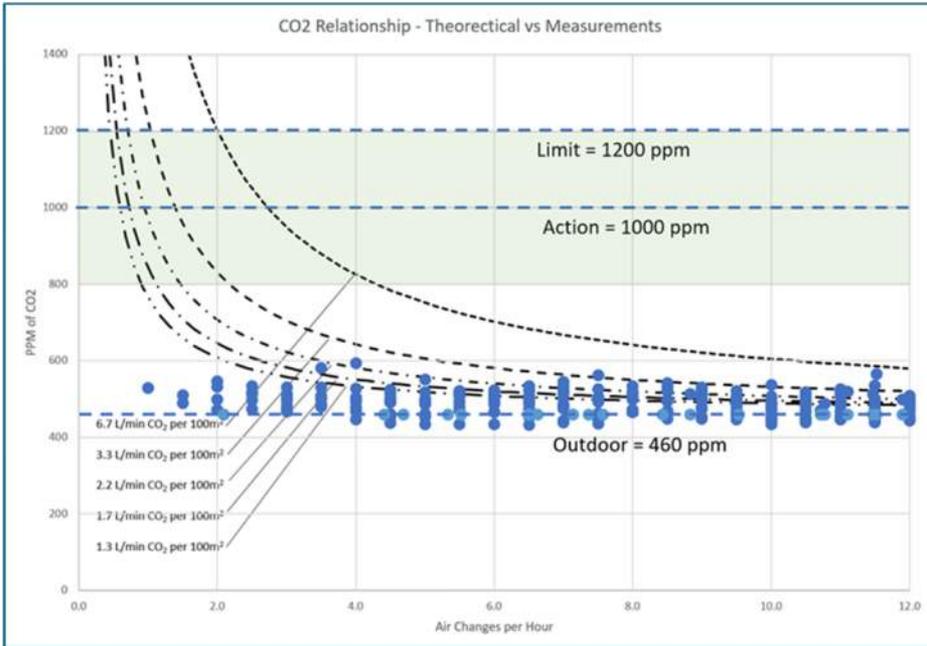
FIGURE 5 Selected air change per hour (ach) rates over the years.³

HISTORICAL AIR CHANGE RATES IN SELECTED NON-OPERATING OR ISOLATION SPACES (TOTAL ACH/OUTSIDE AIR ACH)

	1959	1962	1964	1966	1968	1971	1974	1978	1982	1987	1991	1993	1997	2001	2006	2008	2013
RECOVERY		4	4	4	15/6	15/6	15/6	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2	6/2
NURSERY	8 to 12	12	12	12	15/5	15/5	15/5	12/5	12/5	12/5	12/5	6/2	6/2	6/2	6/2	6/2	6/2
ANESTHETIC STORAGE	2	2	-	8	8/8	8/8	8/8	8	8	8	-	8	8	8	8	8	8
PATIENT ROOM	1.5	1.5	2	4/2	4/2	4/2	2/2	2/2	2/2	4/2	-	2/1	2/2	6/2	6/2	6/2	4/2
INTENSIVE CARE	-	-	-	-	6/6	6/6	6/2	6/2	6/2	6/2	-	6/2	6/2	6/2	6/2	6/2	6/2
LDRP	-	-	-	-	-	-	-	-	-	-	4/2	2	2/2	6/2	6/2	6/2	6/2
PATIENT CORRIDOR	-	-	-	-	-	4/4	4/4	4/4	4/2	4/2	4/2	2	2	2	2	2	2
X-RAY D&T	-	6	6	10	6/6	6/6	6/6	6/2	6/2	6/2	6/2	6	6	6	6	6/2	6/2
EXAM	-	4	4	4	12/6	12/6	12/6	6/2	6/2	6/2	6/2	6	6	6	6	6/2	6/2
MED ROOM	-	-	-	-	-	-	-	4/2	4/2	4/2	4/2	4	4	4	4	4/2	4/2
TREATMENT	4	4	4	12/6	12/6	12/6	6/2	6/2	6/2	6/2		6	6	6	6	6/2	6/2
PHYSICAL THERAPY	-	-	-	-	4/4	4/4	4/4	6/2	6/2	6/2	6/2	6	6	6	6	6/2	6/2
SOILED HOLDING	-	3	3	4	12/4	12/4	12/4	10/2	10/2	10/2	10/2	10	10	10	10	6/2	6/2
CLEAN HOLDING	-	-	-	3	12/4	12/4	12/4	4/2	4/2	4/2	4/2	4	4	4	4	4/2	4/2

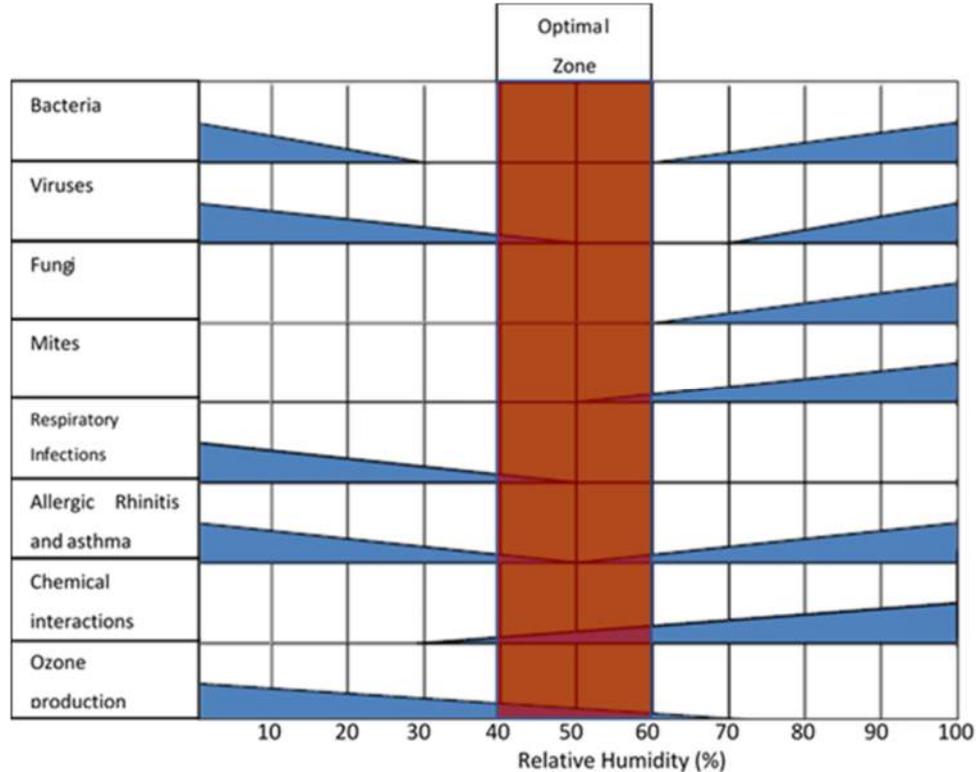
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■ Design solutions



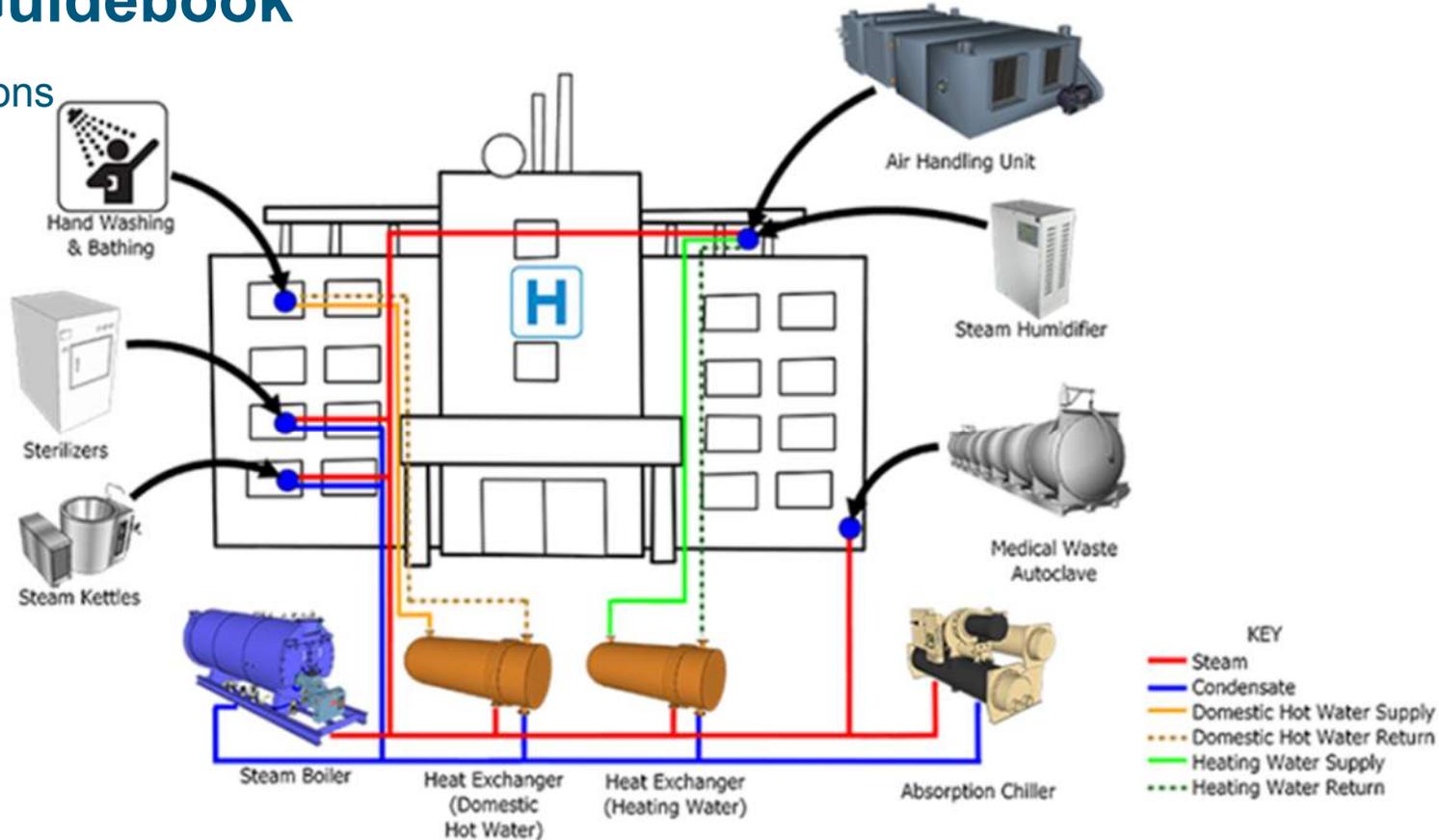
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- Design solutions → Relative Humidity



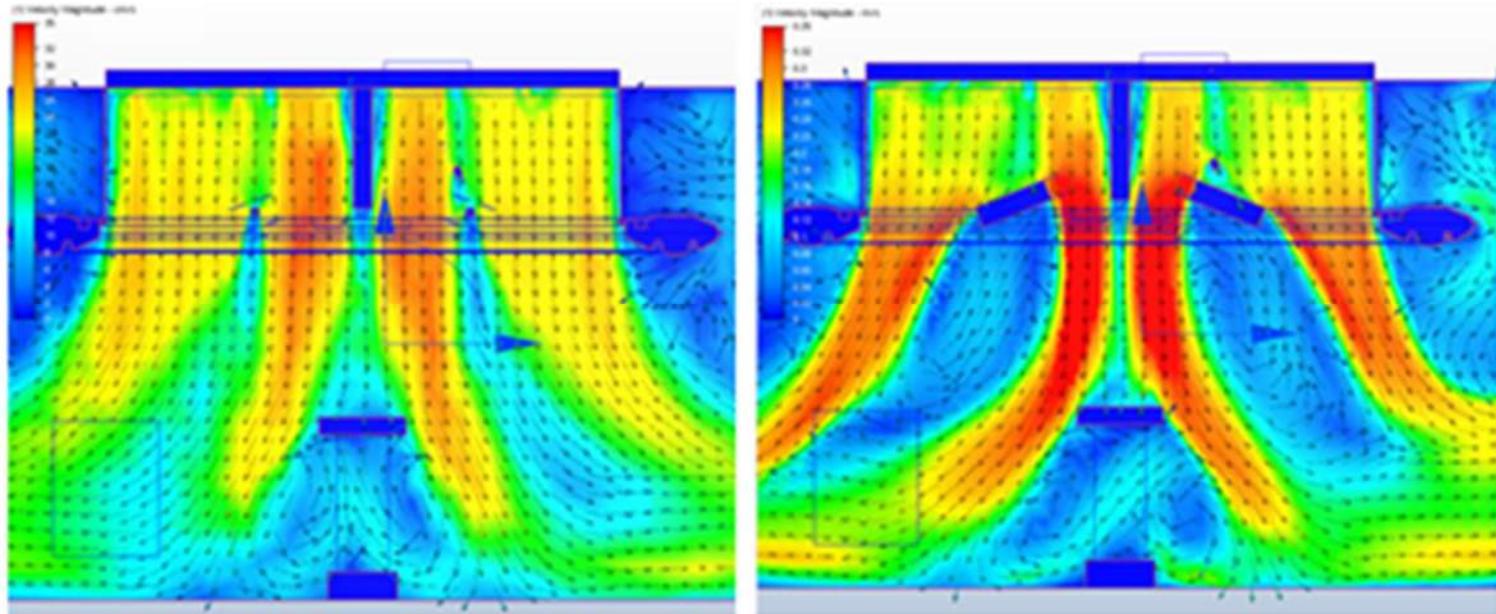
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- Design solutions
- Steam



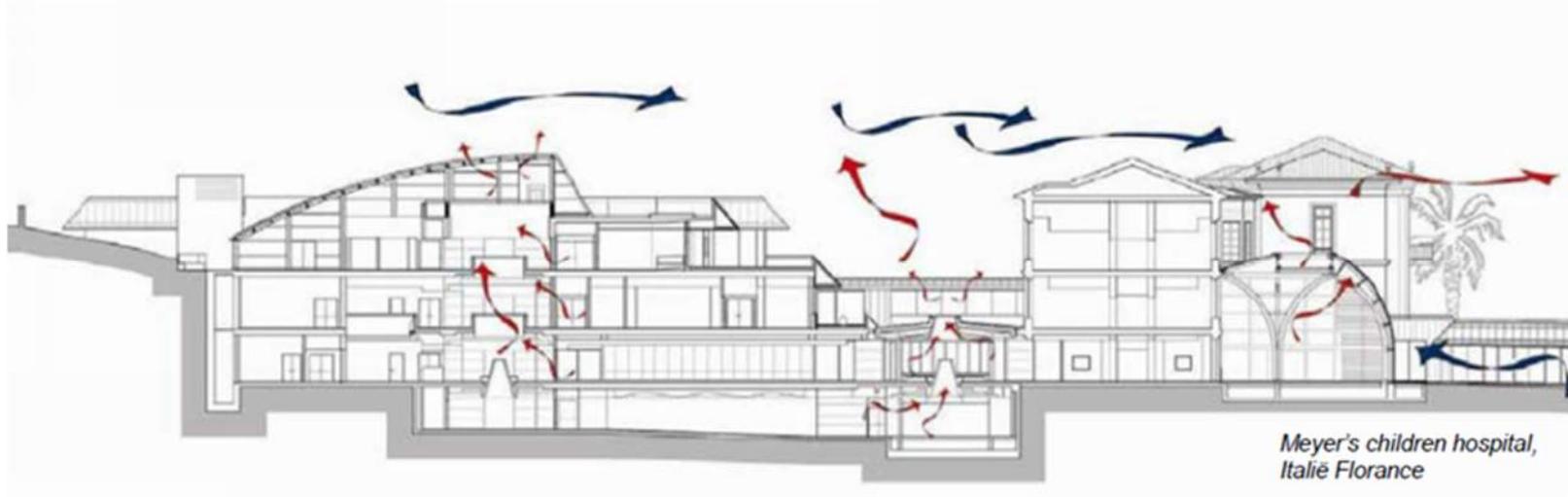
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- Design solutions
Airflow strategies



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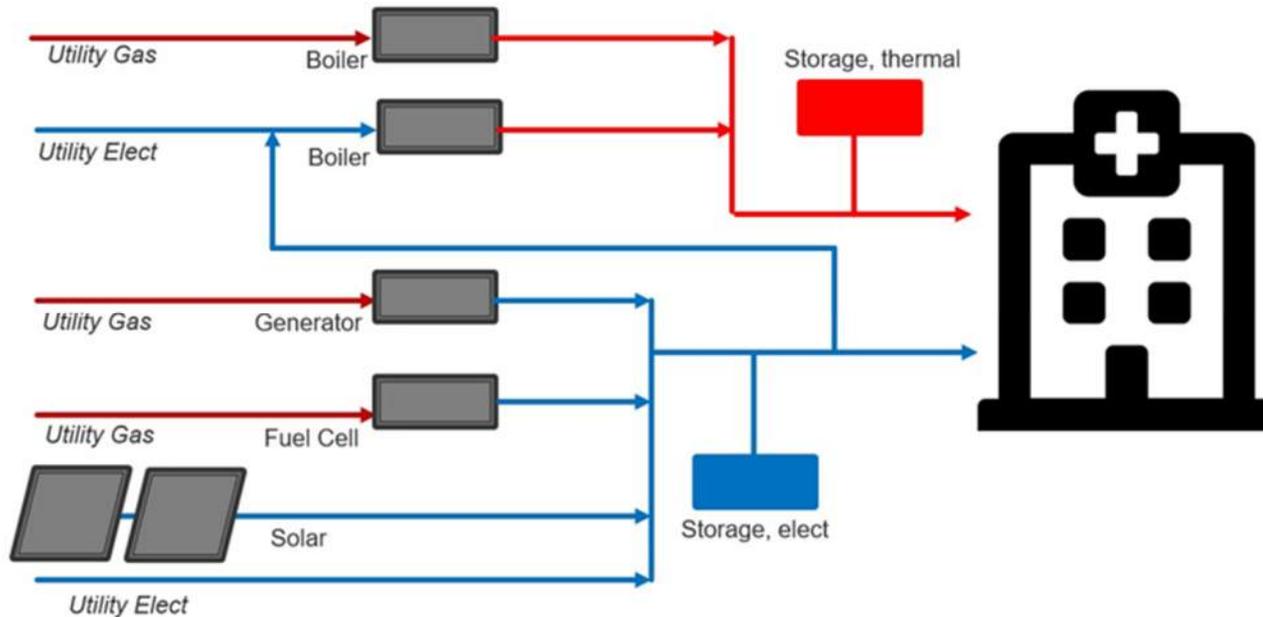
- Design solutions
 - Natural ventilation



Content Guidebook

- Design solutions

Flexibility – "PROSUMAGERS"



Content Guidebook

■ Design solutions Summary

Step	Measures
1. User demand & Behaviour	Lower internal heat loads (more use of stand by mode), smart zoning of the building , smart positioning of building functions, smart and individual control systems (human in the loop, SR ventilation), low flow fume hoods, low energy consuming MRI, combining processes/equipment/test set ups, education of users
2. Reduce Energy Demand	Insulation, envelope airtightness, heat recovery ventilation/hot tapwater, use daylight, thermal mass, positioning of functions and integral design to make application of technologies possible e.g. natural/hybrid ventilation of wards, better Air Handling Units, larger ducts to reduce ventilation energy, variable air flow systems (airflow management), LED lighting, Less heating and cooling (change standards), energy efficient appliances, less or no humidification (clay products for dehumidification in ceilings), use BMS and monitoring to reduce energy consumption and to show and guarantee that systems perform as they should, less tap water stations with hot water supply.
3. Apply Sustainable & Energy Sources	Photovoltaic solar cells, biomass, wind energy, adiabatic cooling
4. Energy Exchange & Storage	Long term energy storage in the soil/acquifer (LTES), short term energy storage (buffers, Phase Change Materials), Concrete Core Activation (TABS), Exchange energy between internal/external functions
5. Efficient use of fossil energy	High efficient boilers, chillers, heat pumps, cogeneration of heat and power

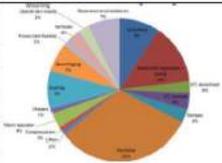
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■ Appendix II – Case Studies

-  Clark Regional MC May 2019 OWNER APPROVED Burpee.pdf
-  GB Case - Erasmus MC 190315 maassen.pdf
-  GB case Bernhoven 190909 maassen.pdf
-  GB Case UMCU Confidential 190909 maassen.pdf
-  GB Case VUmc confidential 190405 maassen.pdf
-  Harrison MC May 2019 OWNER APPROVED Burpee.pdf
-  LPCH Stanford Case_Net Zero Book Jessica.pdf
-  Medical Office Building, Santa Rosa, California USA.pdf
-  Overlake MC May 2019 OWNER APPROVED burpee.pdf
-  Peace Island MC May 2019 CONFIDENTIAL WORKING DRAFT Burpee.pdf
-  Swedish Issaquah May 2019 CONFIDENTIAL WORKING DRAFT Burpee.pdf

Example of Case Study

New Erasmus MC, Rotterdam, Netherlands							
Designers: Architect Structural design HVAC Energy consultant Electrical and automation	architect: EGM struc: Aronrohn building services (MEP): Royal HaskoningDHV building physics: Peutz in care programming of health organisations: pieterse terwel grevink Architect Landscape: Juurlink + Geluk						
Construction year	2017						
Photo or illustration							
Project description	University Medical Center Production facilities: 12 radiotherapy bunkers, 22 OR's of which 1 brachy and 2 hybrid, 4 intervention rooms, 15.000 sqm laboratories Treatment capacity: 522 Medium Care beds, 38 IC-boxes, 18 ICU-boxes, 8 PACU-boxes, 10 Observatory units, 94 day care units, 18 Dialysis units, 5 Pheresis units Ordering principles: Patient first, Identity and human scale, Support of the professional, Efficient hospital management.						
Project Phase	Initiative	Design	Construction	Realized	>3 years operation		
Building address							
Building type	University Hospital	District/Community Hospital	Specialist Hospital	Existing	New	Renovated	
	X				X		

Hospital Building - with hospital functions: outpatient/inpatient-beds, surgery, etc.			
Building size:	207,000 m ² (?? SF)	Number of beds:	522 (medium care)
Building functions	Healthcare with bed	Healthcare without bed	Offices
	21 %	53 %	26 %
Teaching	General (hallways, ...)		
Step 1: Match user Demand and Behaviour	Standby option for Operating Room, Pneumatic tube delivery system		
Step 2: Reduce energy demand Specific features of building envelope and architectural concept	High R-values for the façade (2.5 m ² .K/W), roof (3.5 m ² .K/W) and floors (4.0 m ² .K/W), Green roofs and roof gardens, Sun blinds		
Step 2: Building service systems	Heat Recovery in Air Handling Units, Concrete core activation, Low- and high-temperature distribution systems, Building Management Systems with smart energy meters, Pharmafilter		
Step 3: Apply local renewable energy sources			
Step 4: Energy exchange and storage systems	Aquifer Thermal Energy Storage system		
Step 5: Use fossil fuel efficiently	District heating 70/40		
Delivered energy use (simulated), including both regulated and not regulated energy uses, kWh/m ² a	Heating (space heating and ventilation air)	61 kWh/m ² a	
	Hot water	7 kWh/m ² a	
	Fans and pumps	53 kWh/m ² a	
	Cooling	7 kWh/m ² a	
	Lighting	62 kWh/m ² a	
	Appliances and medical equipment	kWh/m ² a	
	Total delivered energy	kWh/m ² a	
Delivered energy use (measured)	Total delivered energy (measured)		kWh/m ² a
Energy uses not included in the delivered energy			N/A
Exported energy, kWh/m ² a			N/A
Primary energy, kWh/m ² a	Natural Gas (PEF=1.0)	85 kWh/m ² a	Natural gas 9.65 m ³ /m ² per year = 84.8 kWh/m ² per year
	Electricity (PEF=2.56)	489 kWh/m ² a	Electricity 191 kWh-e/m ² per year
	Heat (PEF=0.9)	77 kWh/m ² a	Heating 0.31 GJth/m ² per year = 86.1 kWhth/m ² per year
	Total	651 kWh/m ² a	The energy consumption of the existing part of the Hospital Dijkzigt (1961) = 666 kWh/m ² a (gas= 60; elec= 433; heat= 173)
Primary energy (del. - exported)	0 kWh/m ² a	nZEB minimum requirement for office buildings 100 kWh/m ² primary energy	

Renewable energy ratio	0 % of energy need		
Improvement compared to national requirements	5,4 %	Compared to	HL EPC 2006
Construction cost	??? M€ (??? €/m ²)		
Additional cost of nZEB /Energy Measures	??? €/m ² estimated		
Business case	Building qualities: Safety first, Healing is leading, Sustainable is cheaper in the end.		
www link	https://www6.erasmusmc.nl/nieuwbouw/?lang=en		
References:	Presentation Arjen Windhorst (Erasmus MC), TVVL-Royal HaskoningDHV-TU/e Seminar Towards Zero Energy Hospital Buildings d.d. November 30 th Rotterdam (Erasmus MC) see https://www.tvvl.nl/IV/library/download/urn:uuid:6d424c36-99a4-4bbe-a022-5b21ce05eeca/arian+windhorst:+seminar+ziekenhuizen+op+weg+naar+energie-neutraal:+181130.pdf?format=save_to_disk&text=.pdf		

Examples of measures according 5 step method:

Step	Measures
1. User demand & Behaviour	Lower Internal heat loads (more use of stand by mode), smart zoning of the building , smart positioning of building functions, smart and individual control systems (human in the loop, SR ventilation), low flow fume hoods, low energy consuming MRI, combining processes/equipment/test set ups, education of users
2. Reduce Energy Demand	Insulation, envelope airtightness, heat recovery ventilation/hot tapwater, use daylight, thermal mass, positioning of functions and Integral design to make application of technologies possible e.g. natural/hybrid ventilation of wards, better Air Handling Units, larger ducts to reduce ventilation energy, variable air flow systems (airflow management), LED lighting, Less heating and cooling (change standards), energy efficient appliances, less or no humidification (clay products for dehumidification in ceilings), use BMS and monitoring to reduce energy consumption and to show and guarantee that systems perform as they should, less tap water stations with hot water supply.
3. Apply Sustainable & Energy Sources	Photovoltaic solar cells, biomass, wind energy, adiabatic cooling
4. Energy Exchange & Storage	Long term energy storage in the soil/aquifer (LTES), short term energy storage (buffers, Phase Change Materials), Concrete Core Activation (TABS), Exchange energy between internal/external functions
5. Efficient use of fossil energy	High efficient boilers, chillers, heat pumps, cogeneration of heat and power

Content Guidebook - Recommendations

- Great opportunities to reduce CO2 emissions => pick low hanging fruits using 5 step method and knowledge and experience other building types e.g. offices
- Design starting with considering the human/users and the processes
- Reduce and manage internal heat loads
- Challenge standards and regulations because sometime lacks scientific evidence
- Simultaneous improve primary process and energy efficiency

Thank you!



More information:
Wim Maassen MSc EngD
wim.maassen@rhdhv.com
M 06 537 05 294



ASHE/ASHRAE Decarbonization Design Guide for Hospitals

UPDATE by Walt Vernon

By 2030, the global built environment must at least halve its 2015 GHG emissions, whereby

- all new buildings are **net zero GHG** emissions in operation,
- widespread **energy-efficiency retrofits** of existing assets are well underway, and
- **embodied carbon** of new construction is **reduced by at least 40%**.



Boundaries

- ALL GHGs
- NEW buildings
- HOSPITALS
- NOT regurgitate everything under the sun about how to save energy in hospitals
- ONLY Building-related emissions
- GHG Protocol (vs any others)
- Strong Focus on what is hard/unique
- Because ASHE publication, focus on operational implications
- Organized by Scope (e.g. GHG Protocol, not others)

What is hard:



End Use Loads
(sterilization,
humidification, cart
wash, etc)



Electrification
vs.
“less carbon”
(no cogeneration)



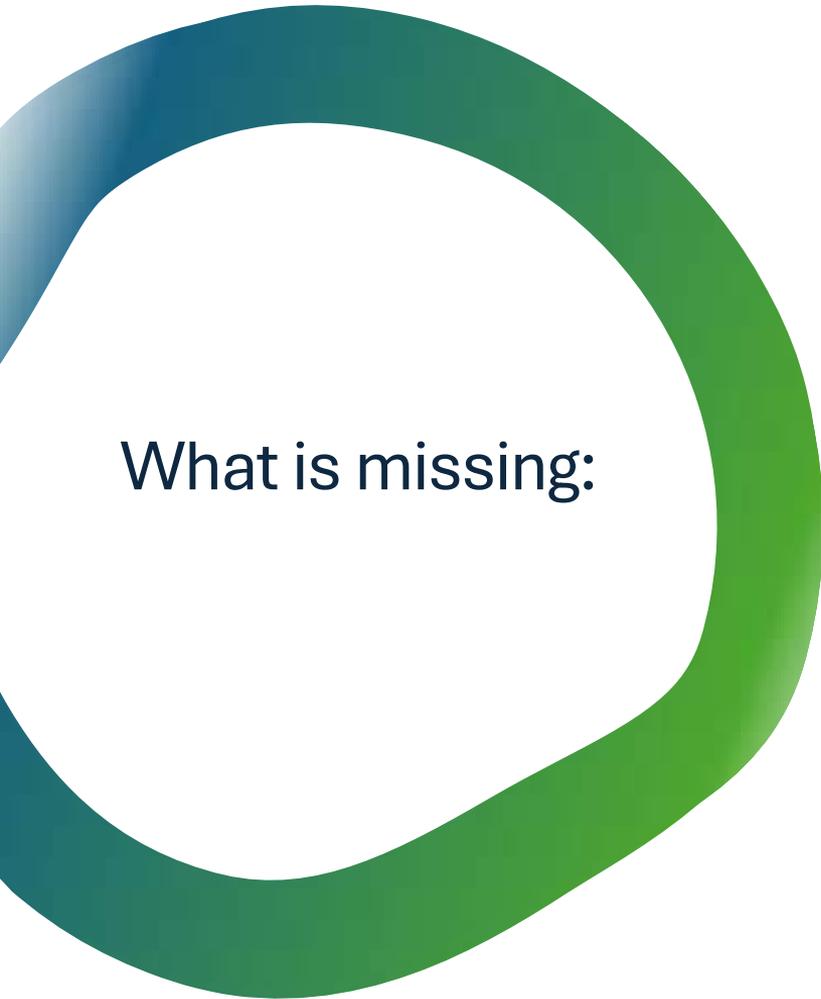
Thermal energy in all
climates



Emergency Conditions
and resilience



Policy observations
and recommendations



What is missing:

- Existing Buildings (but, See Rehva-ASHRAE Guide)
- Model of building for each climate zone
- Model decarbonization codes relevant to healthcare organizations
- Stuff left on cutting room floor

(You may see some of these in CEC Design Guide, ASHE Documents)