

Sustainable Pharma

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Sustainability

In pharmaceutical manufacturing, sustainability can represent two different factors.

- First, sustainability can refer to the idea of protecting the business by mitigating risks that could compromise output and profitability.
- The second refers to reducing the impact of operations on the environment and planetary resources.

Sustainability

- These two concepts come together when pharmaceutical and biopharmaceutical manufacturers consider the cost savings benefits found in reducing the environmental impact of pharmaceutical and biopharmaceutical production.

Nic's Notes

- In a recent article, Justin Madden talks to a 'resilience'
- And Adolfo Fernandez Eco city 2017

Duct Troubles

- Problems can occur when ducts are installed too close to the underside of the slab or structure, limiting the installer's ability to install cleats near the centre of the duct joints.
- Although changes to the National Construction Code (NCC) in 2013 made leakage testing compulsory for duct systems over 3000 L/s, many smaller systems continue to go unchecked, and do not perform as designed. Sean McGowan explores the impacts of leaking ductwork on whole-of-system energy efficiency.

Duct Troubles

- In May 2013, HVAC&R Nation's stablemate publication Ecolibrium, the official journal of AIRAH, published a technical paper authored by Ian Wills, M.AIRAH, that revealed the hidden costs of leaking ductwork.
- Wills was able to demonstrate that the traditionally held view – that air leakage from ducts was insignificant – was a falsely held one. He found that even minor leaks could have a significant impact on plant energy consumption and greenhouse gas emissions.

Duct Troubles

- “Consider a typical air conditioning system in which the designer follows AIRAH DA09 and assumes a supply duct leakage rate of 5 per cent,” wrote Wills.
- “To deliver the design air quantities to the spaces served, the fan must handle $1/0.95$ times the sum of the room air quantities or 105.3 per cent of the nominal airflow. Applying fan laws gives an increase in fan power of 117 per cent, so the widely accepted leakage rate of 5 per cent has added 17 per cent to supply fan energy, for every hour the plant operates.
- “At 10 per cent leakage, the extra fan energy is 37 per cent.”

Duct Troubles

- One may argue, of course, that achieving duct leakage rates below 5 per cent is near impossible, or that the cost would outweigh the potential energy savings.
- But evidence recorded by a leading air tightness specialist has shown that duct leakage rates are commonly 60 to 360 per cent greater than the accepted leak rate of 5 per cent.
- In extreme cases, leakage rates have been found to be as much as 700 per cent of the targeted rate.

Duct Troubles

- According to John Konstantakopoulos, Affil.AIRAH, managing director with Efficiency Matrix, his experience has found that poor sealing occurs in all types of ducts.
- “Usually the larger the duct size, the more problems we expect to find,” says Konstantakopoulos.
- “Our experience has shown that most ductwork we have tested leak between 8 and 18 per cent. In some extreme cases, duct systems can leak above 35 per cent in the initial test.”

Duct Troubles

- These figures have been obtained by Efficiency Matrix from random sampling of ducts to be tested on the day of, or during, a feasibility study for energy efficiency retrofit works.
- Konstantakopoulos says that when advanced notice is given as to what sections of duct will be tested, better performance is generally recorded.
- Not only is fan energy impacted by leaking ductwork, but so too is cooling and heating plant energy consumption.

Duct Troubles

- Wills wrote that the size of the impact is largely determined by the location of the leaking duct.
- “If the duct is in the conditioned space and the leakage percentage low, one might argue that nothing need be done; that is, that the fan can safely supply 100 per cent, not 105.3 per cent of design because the leaked air produces useful cooling or heating effect,” he said.
- But Wills said this is not the case if the duct is in a ceiling return air plenum

Duct Troubles

- “The leaked air will travel around the system producing minimal useful cooling and heating effect while increasing fan power and reducing return air temperature slightly.”
- If the supply duct is outside the conditioned space, such as in a ventilated roof space, the leaked air is lost and the 17 per cent increase in fan energy is compounded by 5 per cent waste in cooling and heating effect and the corresponding increase in greenhouse gas emissions.
- Similarly, Wills explained that the analysis for return air ducts also depends on its location

Duct Troubles

- “Assume that under normal (non-economy cycle) operation the plant handles 15 per cent outside air, in which case return air will be 85 per cent of design supply air.”
- “Leakage at the rate of 5 per cent into the return air duct will thus be 5 per cent of 85 per cent or 4.3 per cent of the design supply air.”

Duct Troubles

- “If the air that leaks in is from outside the building, it adds to the outside air load, the air percentage becoming 15 per cent + 4.3 per cent = 19.3 per cent of the supply air. Since the outside-air load is pro rata, the outside-air load increases by $4.3 \text{ per cent} / 15 \text{ per cent} = 28 \text{ per cent}$.
- For a typical comfort cooling plant in Sydney, 15 per cent outside air would be about 18 per cent of the peak cooling capacity, so the leaked outside air would add ... 5 per cent to the peak cooling load.”

Duct Troubles

- Wills concluded that a 5 per cent leakage rate implies a 17 per cent increase in fan energy on the supply side plus an additional 5 per cent cooling and heating energy if the leakage is to outside the conditioned space.
- An additional 5 per cent waste in cooling and heating energy on the return air side also needs to be factored in, if it increases the outside air percentage.

Duct Troubles

- Of course, such impacts will depend on the type of system employed.
- A variable-air volume (VAV) system with economy cycle will not be affected as much as a constant-volume system with a lower percentage of outside air.
- Wills cited several overseas studies to support his findings, revealing the real-world effect of leaking ductwork.

Duct Troubles

- For example, a study of VAV systems in large commercial buildings in California compared “tight” duct systems (2.5 per cent leakage) to systems with a leakage of 10 per cent.
- It found that those systems with a leakage rate of 10 per cent had an annual HVAC system operating cost 9 to 18 per cent higher than those with “tight” duct systems.
- Duct leakage is dependent on a number of factors, including the duct-surface area and the pressure differential across the duct wall. Yet it is the “tightness” of the duct construction and installation over which HVAC practitioners can have the most influence.

Duct Troubles

- According to Efficiency Matrix's Joseph Cheung, many factors contribute to the poor sealing of ducts.
- "Usually the main issues relate to a limited, accessible workspace around the ducts, which can be caused by design issues or site constraints," says Cheung.
- He says problems can occur when ducts are installed too close to the underside of the slab or structure, limiting the installer's ability to install cleats near the centre of the duct joints.

Duct Troubles

- “This installation method can easily create situations where the foam seal on one side of the duct is rubbed off or rolled up when the custom piece is being slotted in,” he says. “As a result, the seal ends up not being effective.”
- Where ductwork is in the subfloor, it can be prone to damage from tradespeople walking on them, resulting in an inability to create a proper seal, as demonstrated.
- “Improper transport and storage of the duct can also result in the corners of the joining rims being bent or deformed,” says Cheung. “This can easily create gaps that cannot be properly sealed by the typical foam seal used.”

Duct Troubles

- “In one instance, a gap caused by such deformation was found to leak 6 per cent of the design airflow at test pressure.”
- Although such installation issues remain the responsibility of the contractor and/or installer, Cheung says a lack of feedback on non-optimum practices usually results in the contractor or installer being oblivious to the larger impacts of HVAC plant energy efficiency and unknowingly carrying on with poor practices.
- “The other problem is that the industry is focused on the volume of air being delivered at various outlets, as the key performance indicator for HVAC ducts,” says Cheung.

Duct Troubles

- “In some cases, the installer can put the cleat in place with telescopic tools,” Cheung says. “But accessibility issues don’t allow a proper visual inspection to understand how well the cleat is holding the joint together.”
- Poor sealing can also result from the installer not having sufficient space to install custom pieces of duct after all the standard sections have been installed and connected to the riser.
- Cheung sites instances where contractors have had to push the already installed duct pieces to the side to “jam” the custom piece in, due to a lack of margin or tolerance.

Duct Troubles

- “As long as the HVAC contractor meets the air delivery specified, it’s considered a job well done – regardless of the level of leakage.”
- This is compounded by the accepted industry practice of oversizing air-handling plan to meet safety margins.
- “Sometimes the slightly oversized air handler reduces the incentive to improve duct sealing,” Cheung says. “The contractor or installer knows there will be enough slack in the system.”

Duct Troubles

- Although foam seals combined in transverse joints and mastics should effectively seal duct pieces together, successful sealing is not guaranteed without visual inspection.
- Even then, visual inspections can only achieve so much where space is limited or where the seal is covered by other materials such as is the case with insulated ducts or attenuators.
- This is where pressure testing can be used to reveal the true story

Duct Troubles

- “Pressure testing normally reveals the issues, but sometimes it can still hard to pinpoint the leaks even with the help of tracer smoke,” says Konstantakopoulos.
- In his technical paper, Wills also pointed to the challenges leakage testing presents on site.
- Testing disrupts efficient workflow on site. There’s also the problem of the time involved, the cost, and the complication of temporarily closing up the duct.

Duct Troubles

- “The contractor will need to weigh up the cost of careful sealing of ducts at the factory,” says Konstantakopoulos. “They are erected against the potentially greater cost and complication of identifying and rectifying leaks found when the system fails under leakage testing.”
- Wills concluded that research was required to correlate duct-sealing methods to achievable leakage rates.
- “Interrelating these would give the contractor some certainty that if the prescriptive sealing methods are followed, the duct system would be likely to pass the leakage test.

Duct Troubles

- However, Konstantakopoulos says duct sealing is unlikely to ever be properly addressed while the industry remains accepting of the spatial constraints and accessibility issues it is currently presented with.
- “It’s not easy to seal all seams and holes while the ducts are on the ground before installation, and it’s tougher to apply mastic when it’s installed overhead, let alone in tight spaces,” he says.

Duct Troubles

- “In certain situations – such as riser ducts inside speedwall risers, or ducts above highly ornamented plaster ceilings – it is also virtually impossible to retrofit duct sealing using conventional methods.”
- For this reason, the company has developed a fully automated duct-sealing system that achieves costeffective sealing of duct from the inside in buildings where duct leakage rates are high.

Beyond Energy

- As well as impacting negatively on the energy efficiency of the HVAC system, leaks in supply ducts can result in condensation in some areas, which accelerates the deterioration of the sheet metal.
- The same applies to kitchen exhausts where hot-humid air leaks to cool spaces inside or outside the building.
- Short-circuiting of conditioned air is another common issue in leaky ducts, where supply air enters the return stream, bypassing the occupied zone.

Beyond Energy

- “Short-circuiting of conditioned air is not only a direct energy waste but can also mess up the HVAC systems controls due to the mismatching of room temperature and return air temperature,” says Efficiency Matrix’s Joseph Cheung.
- “The thermostat in the conditioned space keeps calling for more cooling while the return-air temperature sensor indicates that the chiller can be turned down.”
- Poor distribution of air, uneven temperatures across the floor and increased occupant complaints can also be symptoms of leaking duct.

Filtering Of Air – The Basics

- Air must be filtered in an air conditioning plant for a number of reasons, not the least being that airborne dust would stick to the wet surface of the evaporator or coil, and eventually block the airflow.
- Another basic reason is that air conditioners introduce a proportion of outside air which can contain dust, pollen, smoke and/or other fumes not wanted in an air-conditioned space.
- Thirdly, ducted air conditioning plants often circulate air from one room or 'zone' to other rooms, and smoke, fumes etc should be extracted before the air is recirculated.

Filtering Of Air – The Basics

- The quality of the filters must be considered on the basis of the level of cleanliness required within the conditioned space. An industrial area may require only the removal of large dust particles.
- A shop or home would require the removal of small dust particles which, for instance, would be visible on polished furniture.
- An office block owner with rented space might consider the cost of regular cleaning and redecorating, and balance the cost of high-quality filtration equipment against cleaning bills; or the owner might select cheap equipment – and employ more cleaners!

Filtering Of Air – The Basics

- Hospitals, laboratories and operating theatres require the filtration of not only dust but also airborne bacteria and other particulate matter measuring less than 0.1 microns in diameter.
- This requires the most sophisticated and costly equipment.

Filtering Of Air – The Basics

The main types of filter in increasing order of efficiency are:

- a) water sprays or wet pads
- b) dry filters made of synthetic cloth materials
- c) viscous filters made of cloth materials coated with adhesive (viscous) fluid
- d) metal viscous filters using a twisted air path and automatic cleaning mechanisms
- e) electrostatic filters, which can be either dry or viscous
- f) absolute filters.

NCC 2019 Energy Efficiency Project

- Rationale

- The Australian Building Codes Board (ABCB) is now almost twelve months into a project to update the energy efficiency provisions in the National Construction Code (NCC), although in reality its planning has been in development for more than 18 months.
- This project was formally initiated by Measure 31 of National Energy Productivity Plan (NEPP), which was agreed to by the Council of Australian Governments' Energy Council in December 2015.

NCC 2019 Energy Efficiency Project

- Rationale

- Measure 31 of the NEPP notes that there is likely to be strong productivity and emissions reductions benefits from revising the NCC's energy efficiency provisions for both residential and commercial buildings.
- However, it also recognises that there is a need to gather more evidence around the effectiveness of the existing provisions, particularly in relation to residential buildings.

NCC 2019 Energy Efficiency Project

- Rationale

- Measure 31 of the NEPP was informed by research commissioned by the former Department of Climate Change and Energy Efficiency in 2012 .
- This research was updated in 2016 by the Department of the Environment and Energy . The updated research found that changes to the NCC could achieve energy savings of up to 53 per cent for commercial buildings, but only up to 18 per cent for residential buildings³ .
- ³ Assuming a learning rate of 3 per cent per annum for 10 years

NCC 2019 Energy Efficiency Project

- Rationale

- On this basis, the ABCB's project has been focussed on increasing the stringency of the energy efficiency provisions for commercial buildings in NCC 2019.
- For residential buildings, the aim is to improve interpretation and compliance with the current provisions, and establish a solid foundation for increasing the stringency beyond NCC 2019.
- The Department of the Environment and Energy is carrying out research into the case for increasing residential stringency in the future.

NCC 2019 Energy Efficiency Project

- Scope

There are four overarching elements to the ABCB's planned changes to the commercial and residential energy efficiency provisions in NCC 2019.

These are:

- Quantifying the Performance Requirements
- Increasing the number of Verification Methods
- Improving the Deemed-to-Satisfy Provisions
- Developing a suite of supporting education material

NCC 2019 Energy Efficiency Project

Commercial buildings (Class 2 common areas, Class 3 buildings and Class 5 to 9 buildings)

In addition to increasing stringency, the planned changes for commercial buildings will:

- Provide a clear target for those wishing to develop Performance Solutions
- Improve the current reference building Verification Method (JV3)
- Recognise Green Star and NABERS Energy as alternative Verification Methods
- Improve the interpretation of the Deemed-to-Satisfy Provisions.

NCC 2019 Energy Efficiency Project

Commercial buildings (Class 2 common areas, Class 3 buildings and Class 5 to 9 buildings)

- These changes will result in substantial energy use and emissions reductions.
- The changes will achieve this by providing more opportunities for low-emissions technologies and innovative approaches to making buildings more efficient.
- It will also complement the voluntary activity of market leaders by recognising buildings rated through Green Star and NABERS Energy.

NCC 2019 Energy Efficiency Project

Residential buildings (Class 1 buildings, Class 2 SOUs and Class 4 parts of buildings)

The planned changes for residential buildings will:

- Provide a clear target for those wishing to develop Performance Solutions
- Provide three Verification Methods at the current, six-star equivalent, stringency (i.e. the reference building Verification Method, NatHERS6 and BASIX7)
- Improve the interpretation of the Deemed-to-Satisfy Provisions.

These changes will provide more compliance options for residential buildings, including a whole-of-dwelling approach through BASIX.

NCC 2019 Energy Efficiency Project

Commercial buildings (Class 2 common areas, Class 3 buildings and Class 5 to 9 buildings)

- Importantly, as part of this work, the ABCB is investigating whether heating and cooling load limits should be applied to residential buildings.
- This would have the effect of improving the performance of dwellings throughout the year by eliminating those designs that perform particularly poorly in either summer or winter. Measures to improve building sealing and reduce condensation risk are also being considered.
- Together, these planned changes for residential buildings in 2019 will ensure the NCC is well-placed for a future stringency increase.

NCC 2019 Energy Efficiency Project

Consultation and analysis

- Importantly, all of the changes that the ABCB is considering will be subject to extensive industry consultation and economic analysis.
- Working groups, with both government and industry members, are already being regularly consulted on technical matters.
- Full public consultation on the draft changes for NCC 2019 will also be carried out in early 2018.

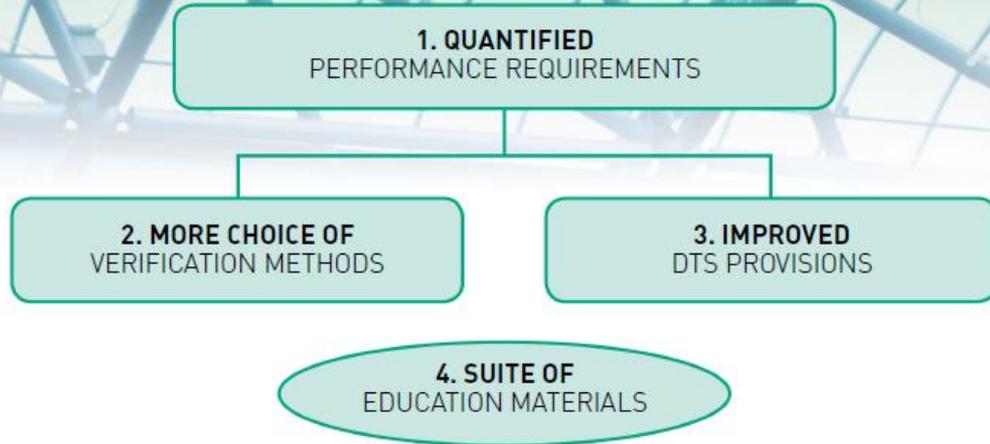
NCC 2019 Energy Efficiency Project

Consultation and analysis

- The draft changes will be accompanied by impact analyses carried out in accordance with the requirements of the Office of Best Practice Regulation.
- This is likely to include an assessment of unintended consequences, such as any fire safety and structural implications arising from the proposed new provisions.

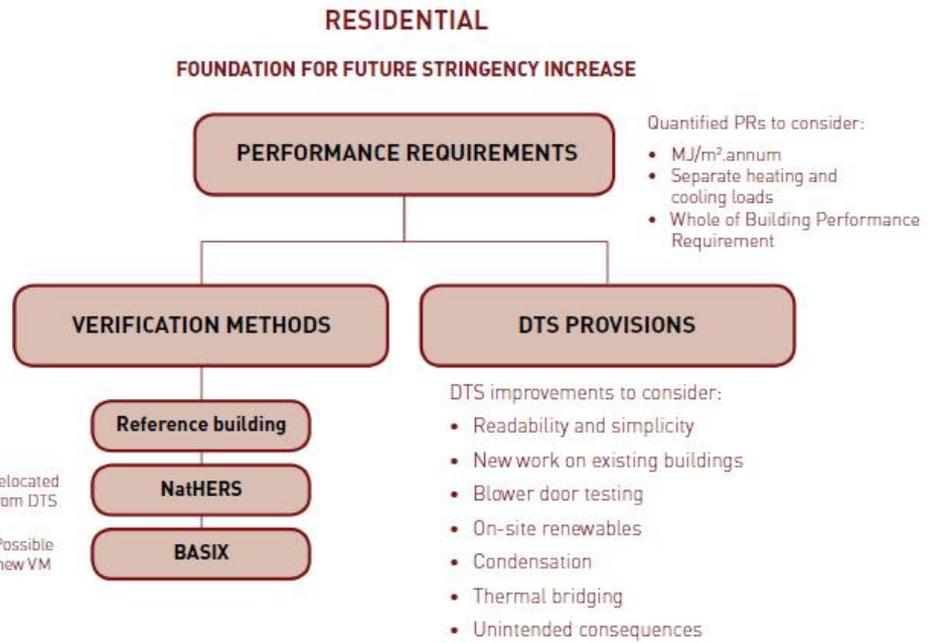
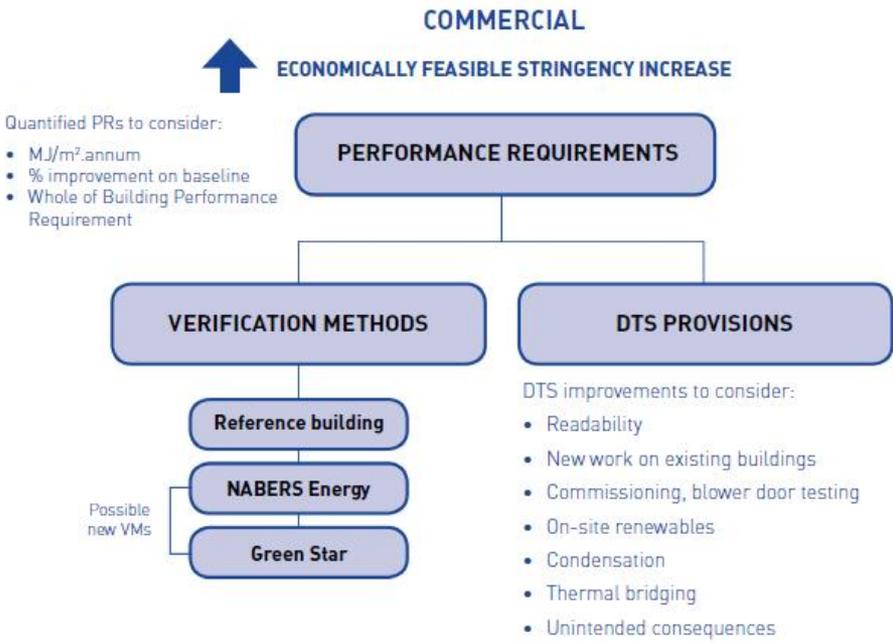
NCC 2019 ENERGY EFFICIENCY PROVISIONS AT A GLANCE

WHY?
 This work was initiated under COAG's **National Energy Productivity Plan** and forms part of the Australian Government's broader strategy to reduce greenhouse gas emissions.



BENEFITS

- Provides more flexibility
- Promotes innovation
- Improves interpretation and compliance
- Accommodates existing tools
- Reduces "red tape"



Australian Building Codes Board

Board
 Chairperson
 9 Government representatives
 5 Industry representatives
 1 Australian Local Government Assoc. Representative

Building Codes Committee
 9 Government representatives
 19 Industry representatives

ABCBC Office

Plumbing Code Committee
 9 Government representatives
 11 Industry representatives

- Develop draft provisions with assistance from:
- Expert consultants
 - Technical committees
 - Working groups

- Work program established through the Building Ministers' Forum and Board
- Board Steering Committee and Working Groups established

- Consultation Regulation Impact Statement development
- Draft provisions finalised and approved for public consultation

NCC public consultation period

Regulation Impact Statement and provisions finalised

Project Specific Committees

Energy Efficiency Board Steering Committee

ABCBC Office

Commercial Working Group

- ACT Administration
- NSW Administration in conjunction with the NABERS Administrator
- Commonwealth Commercial Buildings Team
- Australian Institute of Architects
- Australian Institute of Building
- Australian Institute of Refrigeration, Air conditioning and Heating
- Australian Sustainable Built Environment Council
- Building Products Innovation Council
- Green Building Council of Australia (Green Star Administrator)
- Master Builders Australia
- Property Council of Australia

Residential Working Group

- ACT Administration
- NSW Administration in conjunction with the BASIX Administrator
- Qld Administration
- Tas Administration
- Vic Administration
- WA Administration
- NatHERS Administrator
- Australian Institute of Architects
- Australian Institute of Refrigeration, Air conditioning and Heating
- Australian Sustainable Built Environment Council
- Building Designers Association
- Building Products Innovation Council
- CSIRO
- Cooperative Research Centre for Low Carbon Living
- Housing Industry Association
- Master Builders Australia
- Property Council of Australia

Board approval of new provisions
 New provisions published
 NCC 2019 comes into effect



The Challenges

Companies can quantitatively measure business and environmental sustainability in several ways.

- One important method is to examine the efficiency of utilization, which translates to minimizing waste.
- It is important to note that the pharmaceutical sector is likely the least efficient of all the chemical industries in this area.
- For small molecule pharmaceutical manufacturers, the average waste-to-product ratio is 200/1. Some products achieve ratios of 800/1.

The Challenges

The disparity is even worse in the biopharmaceutical sector with ratios reaching 10,000/1.

- In 2009, pharmaceutical companies in the U.S. reported **530,000,000 tons** to the Environmental Protection Agency.
- At that time, 80 percent of that waste was solvent.
- Energy usage also enlarges a pharmaceutical plant's carbon footprint in addition to increasing expenses.
- In fact, **75 to 85 percent of plant costs** cover some form of energy usage.

The Solutions

Between energy usage and solvent disposal, pharmaceutical plants can generate a lot of carbon dioxide.

- Knowing that, many companies are looking toward repurposing spent organic solvents by incineration to recover stored energy as heat that can be put to use to reduce coal- or other energy-related expenses.
- This method of solvent disposal by conversion to energy can be more cost-effective than the process of purification and reuse.
- It also reduces fossil fuel consumption and carbon footprint.

The Solutions

The growing use of single-use components or systems to replace stainless steel equipment is another solution that is having a positive impact on both company budget sheets and the environment.

- As counterintuitive as it may seem, most plastic single-use components are made from natural gas, so they contain significant amounts of potential energy.

The Solutions

- Being carbohydrates, they break down extremely well, generating more energy per kilogram than coal while producing less carbon dioxide.
- So, not only can biotech companies eliminate huge quantities of water—possibly by 80 percent—and cleaning materials from their production processes with the use of single-use components, they can also reinvest that plastic waste into their energy cycle for an overall carbon footprint reduction of 55 percent in some cases.

The Solutions

- Additionally, pharmaceutical companies are looking to minimize the size of their physical footprint, leveraging smaller, more flexible equipment to maintain output while occupying less space.
- Smaller clean rooms and more agile lines equate to less room air filtration, less cleaning supplies, less wastewater, and ultimately fewer associated expenses.

LG's Solar Powered Factory Case Study

- <https://www.youtube.com/watch?v=f3FYBCexU-g#action=share>

Solar Power Case Study

- A manufacturing plant in Hyderabad installed a 200kw system, 100kw on ground and 100kw on roof.
- Grid connect system, doesn't have a battery and works in tandem with a grid power connection.
- The 200kw system generates 25,000kwh per month in India.
- In 4-5 years the system will have payed for itself.

<http://argosolar.in/commercial-industrial/>

Applying Green Star to a Pharmaceutical Project

Getting started

- Get “buy in” from the whole design team, including all disciplines and, of course, the client
- Get the ESD consultant on board early (e.g. Stage 2).
- For Pharma I would highly recommend using an ESD consultant who has previous experience applying Green Star to controlled environments, e.g. labs, hospitals, healthcare, industrial facilities, etc.
- At the outset, do an initial study on feasibility of achieving Green Star (e.g. this could be done in FEED)
- At the outset, develop a “target rating” strategy

Green Star Rating Feasibility

Start by creating a spreadsheet listing all of the available Green Star credits, and then assign each credit into one of four categories:

- 1 – Credit can be easily achieved with minimal cost impact or design effort
 - 2 – Credit could be achieved but would require some cost impact or design effort,
 - 3 – Credit cannot be achieved within the project constraints,
 - 4 – Credit is “not applicable” (discussed further below)
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- From this, add up the total credits for each category, and determine whether a Green Star rating is feasible, and if so, what a reasonable target rating is, e.g. 4 star, 5 star, etc.

Challenges

Project schedule and project fees

- To demonstrate that the design achieves the target Green Star rating involves significant amounts of documentation and life cycle modelling.
- Potentially some software investment (e.g. life cycle modelling software), or outsourcing to others who have this software would be required.

Non Applicable Credits

- Although it can be applied to any building, the Green Star tool has clearly been developed with commercial office design in mind, and many of the credits are not applicable to a pharmaceutical facility.
- It is possible to get an exemption from the GBCA on credits which are not applicable – this is done by the submission of “Credit Interpretation Requests” – but you must clearly demonstrate why the credit is not applicable, and you would be relying on the GBCA to agree with you, and to approve each exemption.

Non Applicable Credits

- The ESD consultant would be responsible for this.
- Another tricky aspect to this – each credit interpretation request costs \$400 (and you would have a lot of these).
- There is also a waiting period before you get a response from the GBCA (2 weeks on average), so these aspects would need to be allowed for in project schedule and budgeting.

Registration Fees

- Another difficulty is that the GBCA will only start providing formal support once the project is registered - however all registration fees must be paid up front (the registration fee is usually \$20,000 to \$40,000, depending on total project cost).
- So there is a bit of a “chicken and egg” challenge of – how do you determine feasibility before you go ahead and pay the money.

Registration Fees

- Hopefully, given the unique application of pharma, GBCA would see this as an opportunity and might be available to provide support prior to registration(?).
- Also, if we can find an experienced ESD consultant who has worked on similar controlled environments / industrial applications, and we can develop a good “target rating” strategy, I think this risk can be managed.

Lifecycle modelling

- Initially, I would suggest that we get the ESD consultant to help with this, to advise what level of modelling is required, and to make suggestions on how to approach this.
- My understanding is that a lot of ESD teams have this capability, so perhaps it could be part of the ESD consultants scope of work (?)

Benchmark data

- Because pharmaceutical manufacturing facilities are much more energy intensive than commercial office buildings (e.g. the EUI ratio kWh/m² is approximately **15 times greater** than office building according to the attached article)
- We need pharmaceutical industry baseline data to make a reasonable comparison against.
- This benchmark data is used to estimate the typical “Process Loads” associated with our “Reference Building”.

Benchmark data

- We will then show that our “Proposed Project”, has significantly improved on this “Reference Building” to earn credits.
- Note that the “Process Loads” could include process equipment, but it could also include cleanroom HVAC loads, as arguably cleanroom HVAC systems are exempt from NCC “air conditioning” loads (because the primary function of cleanroom HVAC is pressurisation, not occupant comfort).

Benchmark data

- This topic is briefly described in the GBCA “Energy Consumption and Greenhouse Gas Emissions Calculation Guide”.
- We could potentially use US databases such as the International Institute for Sustainable Laboratories (I2SL) and EPA Energy Star® PortfolioManager for benchmark data, but this would need to be investigated further.

Opportunities

- As far as I know, being “the first ever Green Star rated pharmaceutical facility” is still currently up for grabs, and would be a great accomplishment for any client, consultant, contractor, etc.
- There are already lots of good pharma/GMP sustainability resources out there, e.g. ISPE Guide to Sustainability, Energy Star for Pharmaceutical facilities
- There is a strong business case for Green Star buildings, the GBCA has lots of useful brochures, facts, figures, etc. on its website to highlight the benefits to clients / building occupiers

Metering and Monitoring

- **Metering:** accessible metering should be provided to monitor building energy and water consumption.
- Including all energy and water common and major uses as well as sources.
- **Monitoring Systems:** The monitoring system should be able to capture and process the data produced by the installed energy and water meters and accurately and clearly present data consumption trends.

Lighting Comfort

- **Minimum lighting comfort:** Lights should be flicker-free and accurately address the perception of colour in the space.
- **General illuminance and glare reduction:** lighting levels and quality comply with best practice guidelines.
- Glare is eliminated.

Lighting Comfort

- **Surface illuminance:** a combination of lighting and surfaces improve uniformity of lighting to give visual interest.
- **Localised lighting control:** occupants have the ability to control the lighting in their immediate environment.

Peak electricity demand reduction

- **Prescriptive pathway:** the use of on-site electricity generation systems reduces the total peak electricity demand by at least 15%.
- **Modelled performance pathway:** the projects predicted peak electricity demand has been reduced below that of a reference building.

Peak electricity demand reduction

- **Demand response ready HVAC systems:** all installed air conditioning equipment is Demand Response Ready (DDR).
- Also have an activated receiver that is connected to a distribution network provider approved peak demand reduction program.

Recycling of building materials

- **Structural and reinforcing steel:** 95% of the building's steel is sourced from a responsible steel maker.
- For steel framed buildings, at least 60% of the fabricated structural steelwork is supplied by a steel fabricator/steel contractor accredited to the Environmental Sustainability Charter of the Australian Steel Institute.
- For concrete framed buildings at least 60% of all reinforcing bar and mesh is produced using energy-reducing processes in its manufacture.

Recycling of building materials

- **Timber products:** 95% of the timber used in the building have been certified by a forest certification scheme or is sourced from a renewable source.
- **Permanent formwork, pipes, flooring, blinds and cables:** 90% should not contain PVC and have an Environmental Product Declaration or Meet Best Practice Guidelines for PVC.

Recycling of building materials

- **Reduction of construction and demolition waste:**
- Construction waste going to landfill should be reduced by minimising the total amount of waste sent to landfill when compared to a typical building.
- Or a significant amount of waste should be diverted from going to landfill as a proportion of waste generated.

Reduce light pollution (external lighting)

- **Light pollution to neighbouring bodies:** the project should comply with AS 4282: 1997 *Control Of The Obtrusive Effects Of Outdoor Lighting*

Green Star Carbon Zero Buildings

Among the key changes to Green Star, are:

- minimum requirements for greenhouse gas emissions for 5 and 6 Star Green Star buildings
- measures to build industry capacity in air-tightness testing
- a new materials pathway to incentivise the use of sustainably-sourced structural timber and
- new requirements to enhance the health and wellbeing of construction workers.

Minimum Requirements For Greenhouse Gas Emissions

- A project with 5 Star Green Star certification is now required to achieve three Green Star points in the 'Greenhouse Gas Emissions' credit, and be 25 per cent more efficient than a benchmark building.
- A 6 Star Green Star building must achieve a minimum of six points and demonstrate efficiency of almost 40 per cent above the benchmark.

Air-tightness testing

- Changes to the '**Commissioning and Tuning**' credit have been made to accelerate the uptake of air-tightness testing.
- A new '**Air Permeability Performance Testing**' requirement is now part of a core component of the credit, contributing to the achievement of two points.

Structural timber

- A new 'prescriptive pathway' for the use of structural timber aims to incentivise the material's use.
- While the initial intention was to recognise engineered timber, such as Cross-Laminated Timber and glulam.
- After seeking industry feedback the scope of the credit was expanded to include all sustainably-sourced structural timber.

Enhancing The Workplaces Of Construction Workers

- The '**Construction Environmental Management**' credit has been renamed '**Responsible Construction Practices**', with a new point available for project teams that can demonstrate high quality staff support through health and wellbeing programs.
- "Research has found the mental health of employees on construction sites does not meet that of other industries. This change to Green Star is about recognising that a building is not truly sustainable if it doesn't look after the workers who constructed it," *GBCA's Head of Market Transformation Mr Jorge Chapa.*

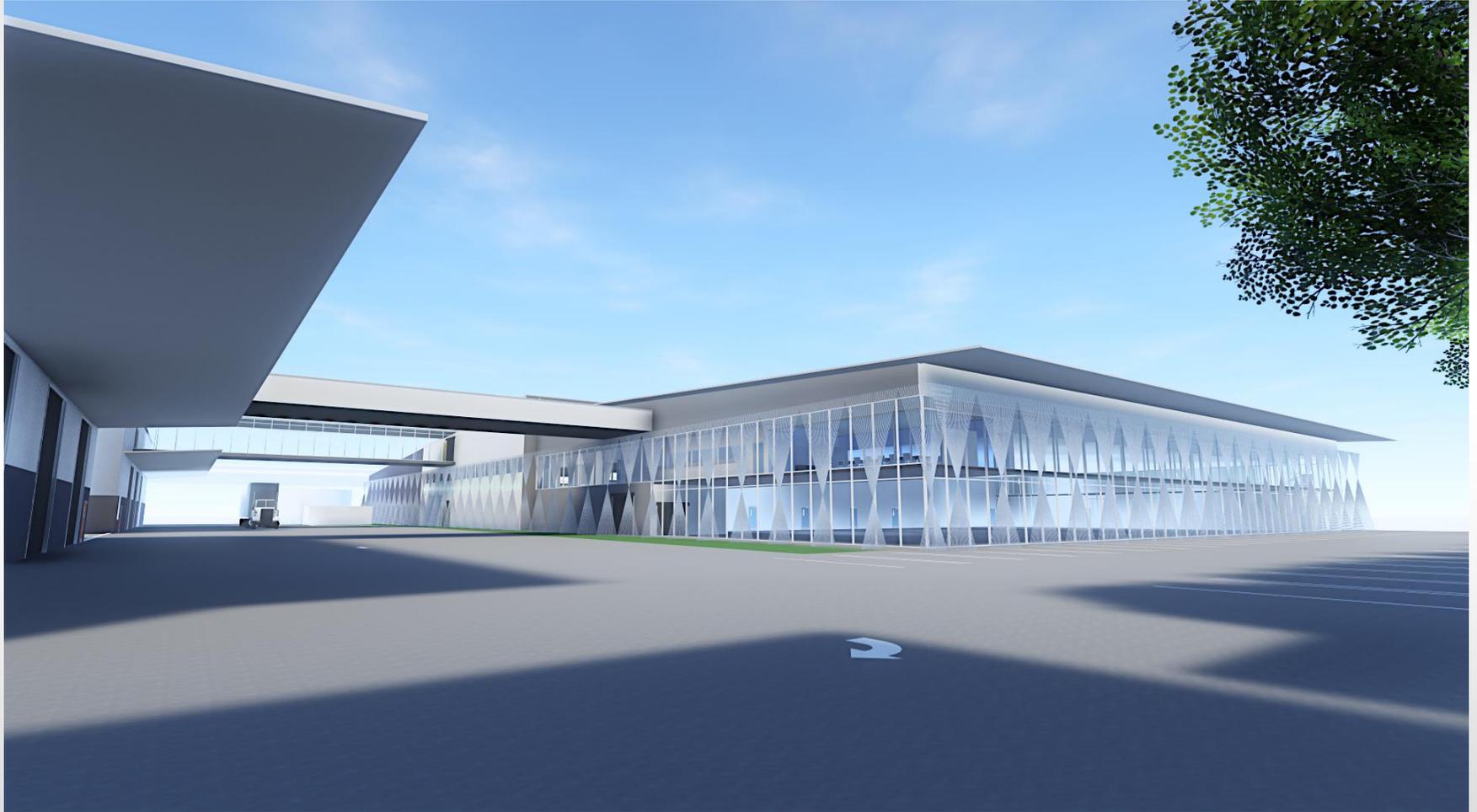
Other Changes To Green Star

- Other small changes are being made to Green Star. New Innovation Challenges on Carbon Neutrality will be introduced in the coming weeks, while others are being rolled into existing credits; and loop holes are being removed that enable double counting.

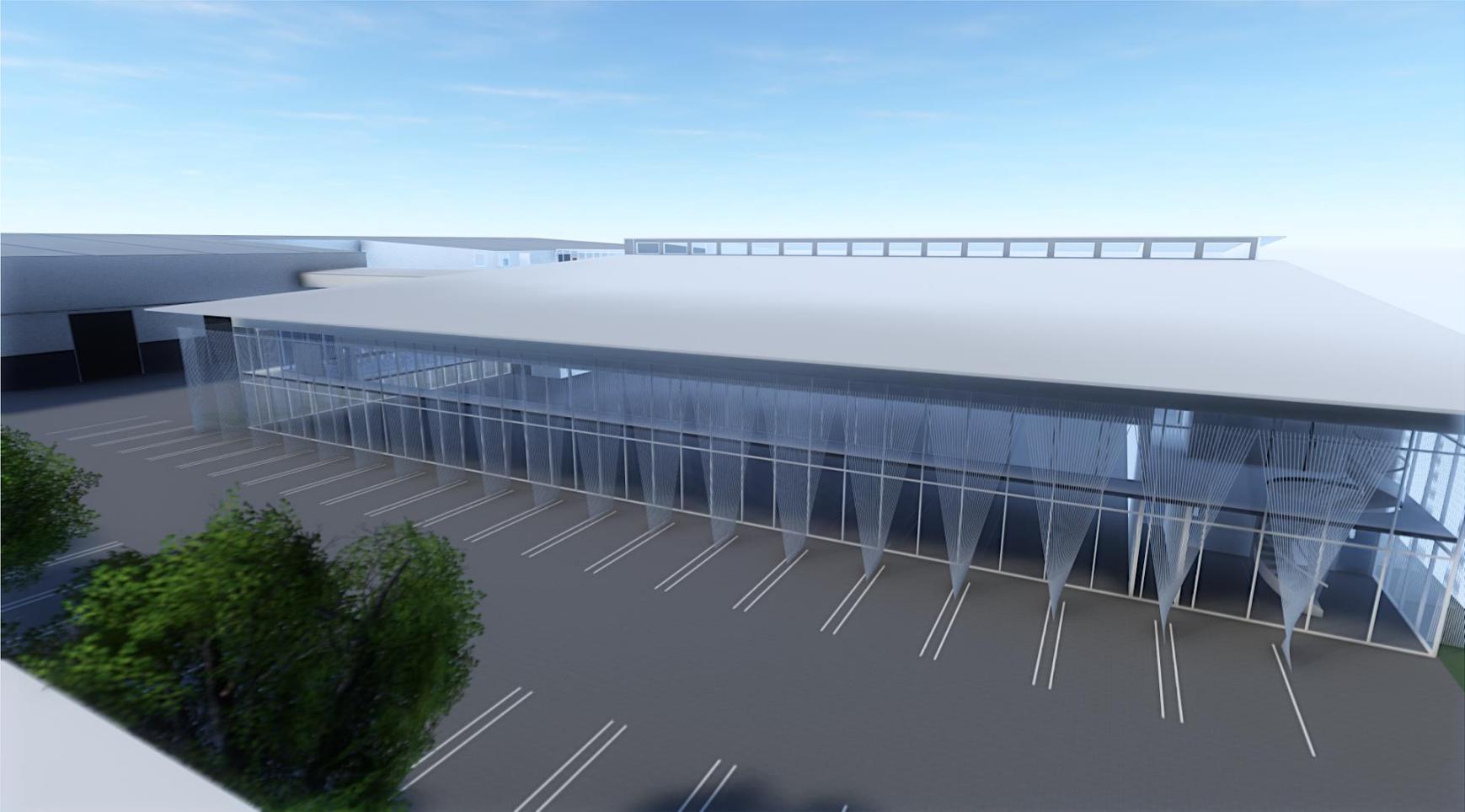
Green Star Rating

- Registrations under the legacy versions of the rating tools will be accepted until 30 September, after which time all projects will be registered under Green Star – Design & As Built v1.2 and Green Star – Interiors v1.2. Project teams working with legacy tools will be able to upgrade their Green Star submission on a credit-by-credit basis.

UAH Building Envelopes



UAH Building Envelopes



First Principles



Airtron AC energy saver

Kishore Mansata

- Sole Patent holder of the Airtron AC Energy Saver, world's first and only sensor-driven Programmable unit that saves upto 40 % electricity and maintains the precise set temp.
- Magnatron International
- St. Xavier School - kolkata
- Kolkata, West Bengal, India
- 500+ 500+ connections

- He has a patent published on Airtron the world's first and only dual sensor driven retrofit microprocessor which saves upto 40 % electricity while maintaining and displaying the Set Temp.

Airtron AC energy saver

- The Airtron is equipped with with Dual Sensors & Display , & references the Room, Coil & Ambient Temperature and using multiple Algorithms in a “Closed-Loop” Circuit to achieve this.
- The Dual Sensor -Driven Airtron adds “Intelligence” to any AC to virtually function as a Precision AC ,and is supplied with a Remote, to set your Room Temp.
- The Patent was filed in 2011 and published in 2013. The Airtron offers a payback of only 3-5 months.

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