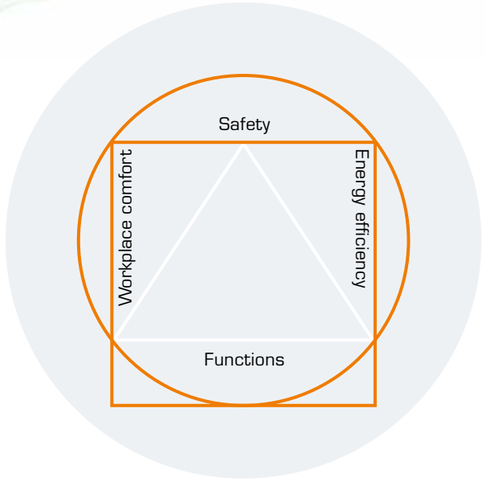
Energy-efficient, demand-based lab ventilation.

In order to optimise the use of energy and thereby considerably reduce the operating costs of a lab, volume flow rates have to be reduced to the minimum that is feasible from a hygienic point of view. This is the way to make ventilation and air conditioning as efficient as possible.

The Swiss H.Lüdi + Co. designs and develops pioneering systems for the construction and equipment of modern labs.



Squaring the circle in ventilation and air conditioning.

An air conditioning system must try to achieve a balance between effective air distribution, energy efficiency, and safety and comfort of the people in the workplace.

Requirements on lab ventilation.

Ventilation and air conditioning are energy-efficient only if they meet the following requirements:

- adapting volume flow rates to demand, i.e. to room usage
- adapting fan speeds to the air requirement
- balancing supply air and extract air flows
- automatic balancing of volume flow rates
- minimising pressure losses caused by dampers
- communication of all system components
- smooth integration with the central BMS

A ventilation and air conditioning system that meets such high requirements is bound to reduce the energy consumption in labs.

Significantly increased energy efficiency in labs.

Prompted by an initiative by the Swiss company H.Lüdi, TROX and TROX HESCO Switzerland have developed an innovative ventilation and air conditioning solution that is bound to help achieve considerable energy reductions in lab buildings.

Advanced system solutions for modern labs.

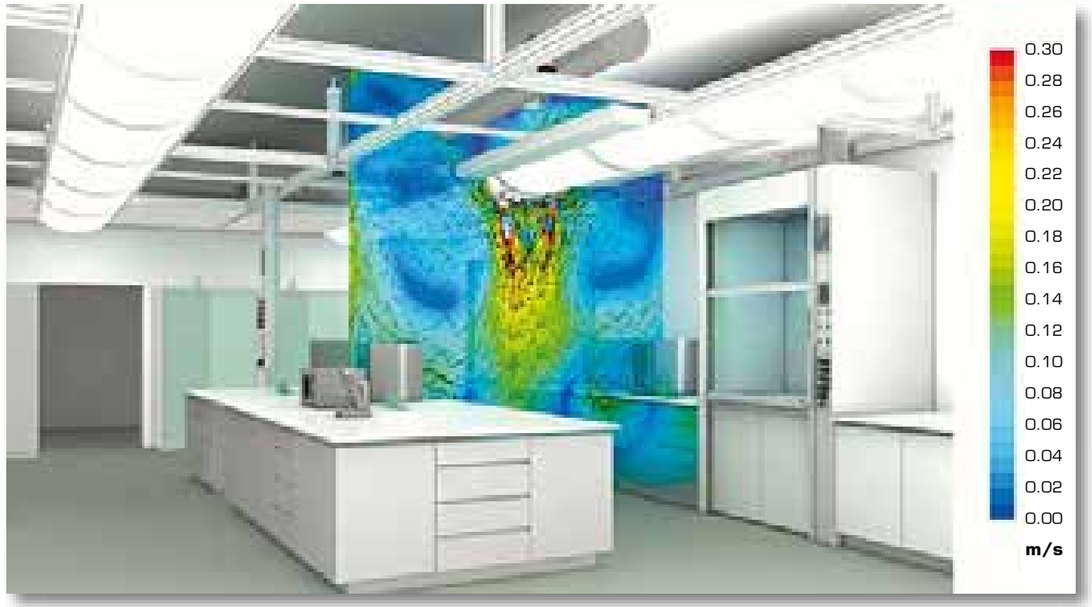
H.Lüdi specialises in the development of advanced system solutions for the construction and equipment of labs. The company provides the well-known high Swiss quality and has been working with TROX GmbH for many years. When it comes to lab equipment, H.Lüdi is actually a pioneer and an innovator, be it with BIM, or Building Information Modelling, be it with their innovative modular equipment that facilitates and speeds up installation and assembly, or thanks to innovative ideas that lead to energy and cost savings.

Design, sizing and installation – H.Lüdi offers the entire lab infrastructure from a single source: electricity, water, gas, pipe networks and ventilation components, including wiring and interconnection. For ventilation components and systems, H.Lüdi has relied on TROX for many years.

Turbulence-free airflow.

A turbulence-free airflow creates layers of air that are free from draughts and stalls. The air in a space rises and takes heat loads and any undesirable particles to the upper part of the space, from where they are then efficiently removed. Only the occupied space up to 2.50 m has to be cooled with fresh air. This is yet another advantage of the removal of heat loads. An ideal air distribution strategy combined with a decentralised heating, cooling and ventilation system ensures that heat loads of up to 150 W/m² are dissipated.

Energy reduction of up to 30% – ventilation based on thermodynamic principles ensures maximum efficiency.



H.Lüdi is committed to providing the best possible, energy-efficient lab equipment and furniture for the highest work comfort.

Changing requirements on lab ventilation.

Ventilation and air conditioning not only aim at providing comfort for room occupants; the more important aspects are actually safety and energy efficiency. High thermal loads have to be dissipated; with a conventional system, this requires huge quantities of fresh air.

This is why split units are often used for additional cooling. They do have a disadvantage, though: Cold air is blown into a space at a high velocity, and not through the supply air outlets, but against the airflow provided by the central system, thereby thwarting an ideal air distribution and dissipation strategy. Energy efficiency and thermal comfort suffer.

Years ago, most labs were so-called wet labs. They would require at least eight air changes per hour for an effective removal of chemical or other hazardous substances and to protect the lab staff. These days, however, research in a lab focuses on other jobs, such as analysing the water quality or food analyses. Biotech labs are also very common. As a consequence, fewer and fewer fume cupboads are needed, or none at all, so that fewer air changes are required. Also, labs may not be fully occupied at all times, which is another reason for a lower fresh air requirement. Changing requirements lead to new approaches: fewer air changes when there are fewer fume cupboards because air that is extracted has to be replaced, i.e. supplied again. And this can be expensive.

Depending on the requirements, heat loads can be dissipated more efficiently and more comfortably than with conventional systems. Not to forget, intelligent control systems consider both occupancy and the number of currently active or inactive fume cupboards, so that less fresh air is required.

The basic idea: simple, yet brilliant.

- When a lower occupancy of labs and a lower contamination of the room air require less fresh air,
- when heat loads can be dissipated more efficiently and cooling could be more energy-efficient,
- when fume cupboards are integrated in an intelligent control network,
- when there are integrated sensors that forward information to each component and to the central BMS,
- and when components are designed for efficient air distribution and simple integration into the lab ventilation system, …

… then a system should be used that combines supply air, extract air and recirculated air. Ideally, all these functions should be provided by a single unit that ensures an ideal air pattern.

Instead of a strategy based on supply air alone, the more efficient ventilation and air conditioning system is expanded by the following elements per unit:

- An air-water heat exchanger for supply air ensures that heat loads are dissipated more efficiently. Heating and cooling will be more efficient due to the ventilation system.
- An integrated, intelligent control system makes it possible to minimise the fresh air flow rate based on occupancy.
- Radiators, air heaters, split units, active chilled beams, cooling with recirculated air, and chilled ceilings or canopies are – in contrast to conventional systems – no longer needed and do hence not have to be balanced with one another. Much heating is usually not necessary in labs due to the high heat loads. However, if the difference between heating and cooling is small, adaption of the radiators will be slow and they may actually work against cooling.

All these varying requirements were taken into account, and an integration strategy for all the important functions has been developed. These functions are now included in one system that combines the hardware and software for heating, cooling, fans and sensors, and that meets the following requirements:

- reaction to varying demands (real demand based), with demand-based ventilation and air conditioning
- use of a heat exchanger that dissipates heat loads with water
- considering various pressure conditions, for example due to HEPA filters as they cause more pressure loss
- optional use of smaller and more energy-efficient EC fans* in a UBox. Such ‘supporting fans’ ensure that the duct pressure can be reduced and that the air handling unit can run with less pressure and a lower total volume flow rate, i.e. that a smaller duct network may suffice. This also helps to save costs.

In a nutshell: lab requirements today

1. Smaller volume flow rates
2. Handling of high heat loads
3. Prevention of cross contamination
4. Heterogeneous environments
5. Comfortable usage

** The EC fan (EC = electronically commutated) is driven by a brushless DC motor. Such motors use a permanent magnet in the secondary field. DC running through the wire winding creates a magnetic field, providing the power which runs the motor.*
This is more efficient and saves up to 70% of energy.

EASYLAB – UBox: everything included.

1. Temperature sensor
2. Volume flow rate sensor
3. Differential pressure measurement
4. Non-return damper
5. Secondary air filter
6. EASYLAB control system
7. Heat exchanger
8. Patented supply air sound attenuator
9. EC fan
10. Patented extract air sound attenuator

Preassembled and complete – the UBox (U = Umluft, or recirculated air): everything from an EC fan and sound attenuators to heat exchangers, filters and an intelligent control system with sensors.

All these considerations found their expression in the so-called UBox, which TROX and H.Lüdi developed for lab ventilation and which has just been installed in a Swiss lab for the first time. Depending on how much fresh air is required for a zone, the UBox takes in more or less room air, which is then mixed with the fresh air and supplied to the room again. Heat loads are efficiently dissipated with water thanks to the integral heat exchanger. The smart EASYLAB control system controls supply air and extract air flow rates based on demand. EASYLAB also controls pressure conditions if several rooms have to be kept separate with different room pressures.

The UBox can simply be integrated with an existing system and ensures that thermal loads are dissipated safely, efficiently and comfortably.

> The reason the cooperation with TROX has been so successful', explains Hansjürg Lüdi, 'is because we have the same method of approaching problems and we are both committed to finding the best possible solution. The technical support was excellent, the intelligent products and especially the EASYLAB control system have allowed us to achieve a system in which the components are working together perfectly.
>
> We were convinced of our idea and had the courage to follow through with it and install this system for the first time. We expect a considerable reduction of the life cycle costs and hope to reach the break-even point soon.

CROFCU – what was that again?

In a joint project with Daldrop + Dr.Ing.Huber a few years ago, TROX developed CROFCU, a system similar to the solution introduced here. Daldrop + Dr.Ing.Huber specialise in clean room systems, and X-CUBE CROFCU, which works with another control system, allows for considerable energy savings in the ventilation of clean rooms. For more information please refer to TROX life 'Clean room air'.

Conclusion.

- Up to 50% reduction of energy consumption when compared to existing solutions.
- More comfort thanks to the ideal air discharge and distribution.
- Easy connection of the ventilation system to the central BMS with plug and play.