



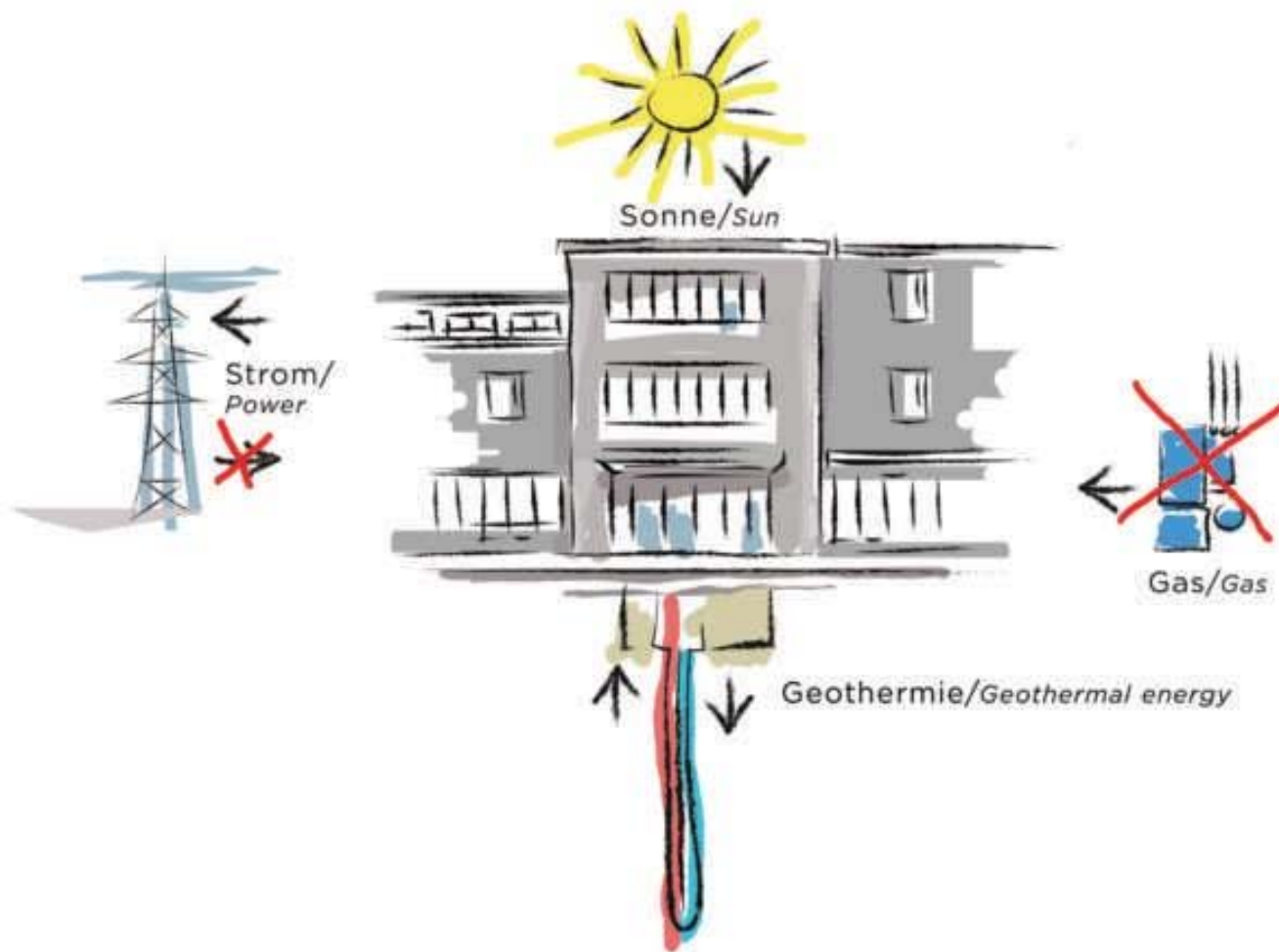
PLUS ENERGIE SCHULE STUTTGART 2019

Robert Schild



DIE VISION 2050 – KLIMANEUTRALE GEBÄUDE

THE VISION FOR 2050 – BUILDINGS WITH A NET-ZERO ENERGY FOOTPRINT



**DIE SCHULE IST FÜR RUND 450 SCHÜLER IM ALTER VON 6 BIS 16 JAHREN
THE SCHOOL IS DESIGNED FOR ABOUT 450 PUPILS BETWEEN SIX AND SIXTEEN YEARS OF AGE.**

**Hauptgebäude /
Main building (1954)**



**Erweiterungsgebäude /
Expansion building (2004)**



EXISTING BUILDINGS



Nordfassade
North facade

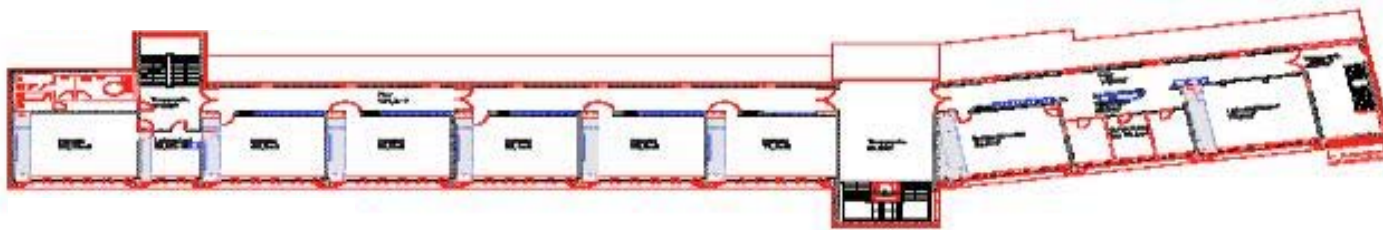


Klassenräume
Class rooms

MAIN BUILDING 1,200 m², THREE STORIES ABOVE GROUND, ONE BELOW GROUND



Südfassade | *South facade*



Nordfassade | *North facade*





DENKMALSCHUTZ *PROTECTED CULTURAL ELEMENTS*





THE BUILDING

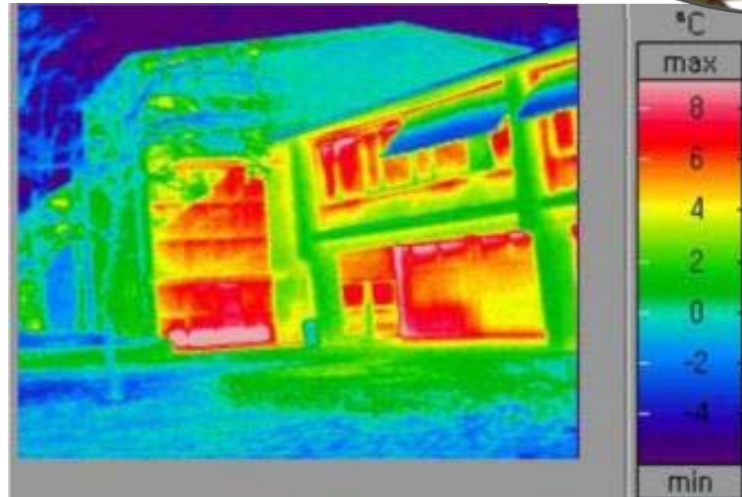
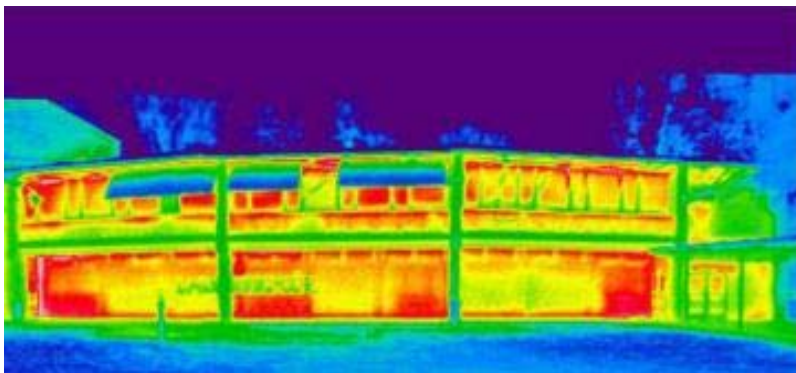


- Main building from 1954
- Base area of Building 1,200 m²
- Three aboveground and one underground floor
- Classrooms for about 450 students and a caretaker's apartment
- Storage and technical rooms in the basement
- Reduction of heat loss through the building envelope by 80%



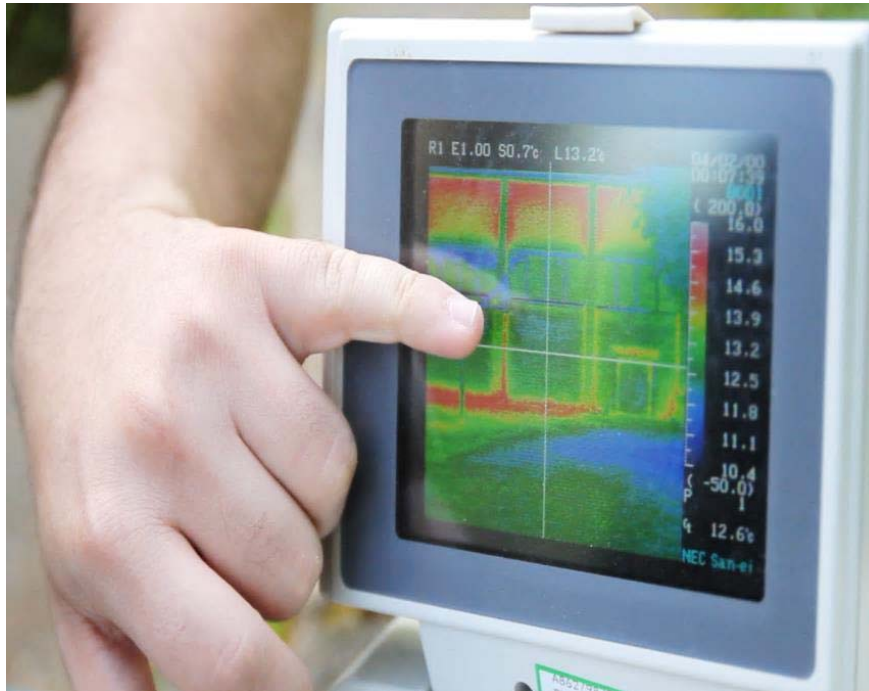


THERMOGRAPHIC ANALYSES





ASSESSMENT AND ANALYSIS





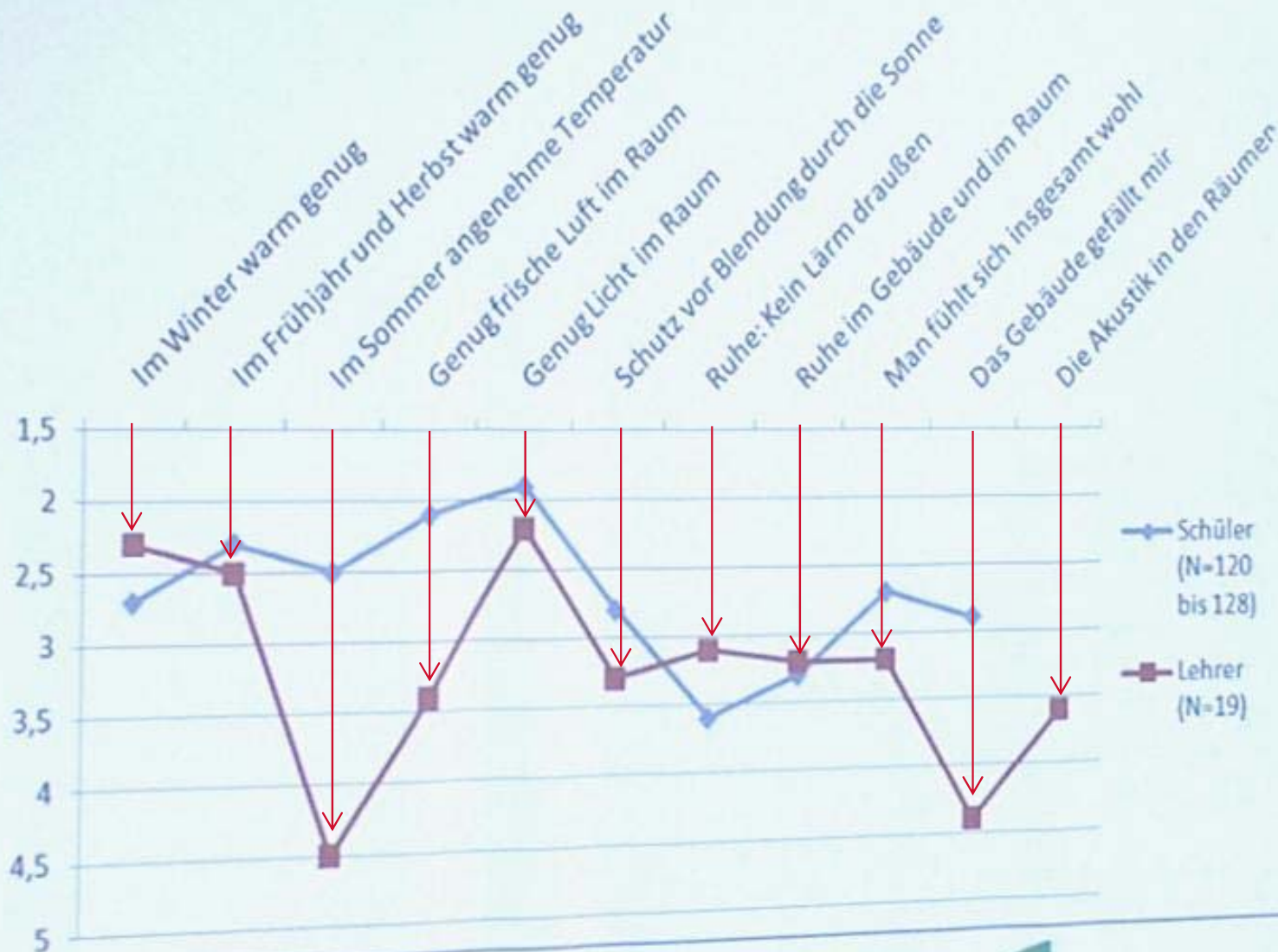
PREPARATION AND PARTICIPATION

Dr. Annette Roser
IREES GmbH - Institut für
Ressourceneffizienz und
Energiesstrategien



Beurteilung des Raumklimas durch Schüler und Lehrer

Mittelwerte (in Noten)



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ENERGIEVERSORGUNG DER PLUSENERGIESCHULE ENERGY SUPPLY OF PLUS-ENERGY SCHOOL



PV-Module zur Stromerzeugung /
PV modules to generate power
Stromüberschuss in das öffentliche
Netz / *Overflow of power into the
public network*

Tageslichtnutzung und Sonnenschutzsysteme für
natürliche Belichtung / *Use of daylight and sun
protection systems for natural light exposure*



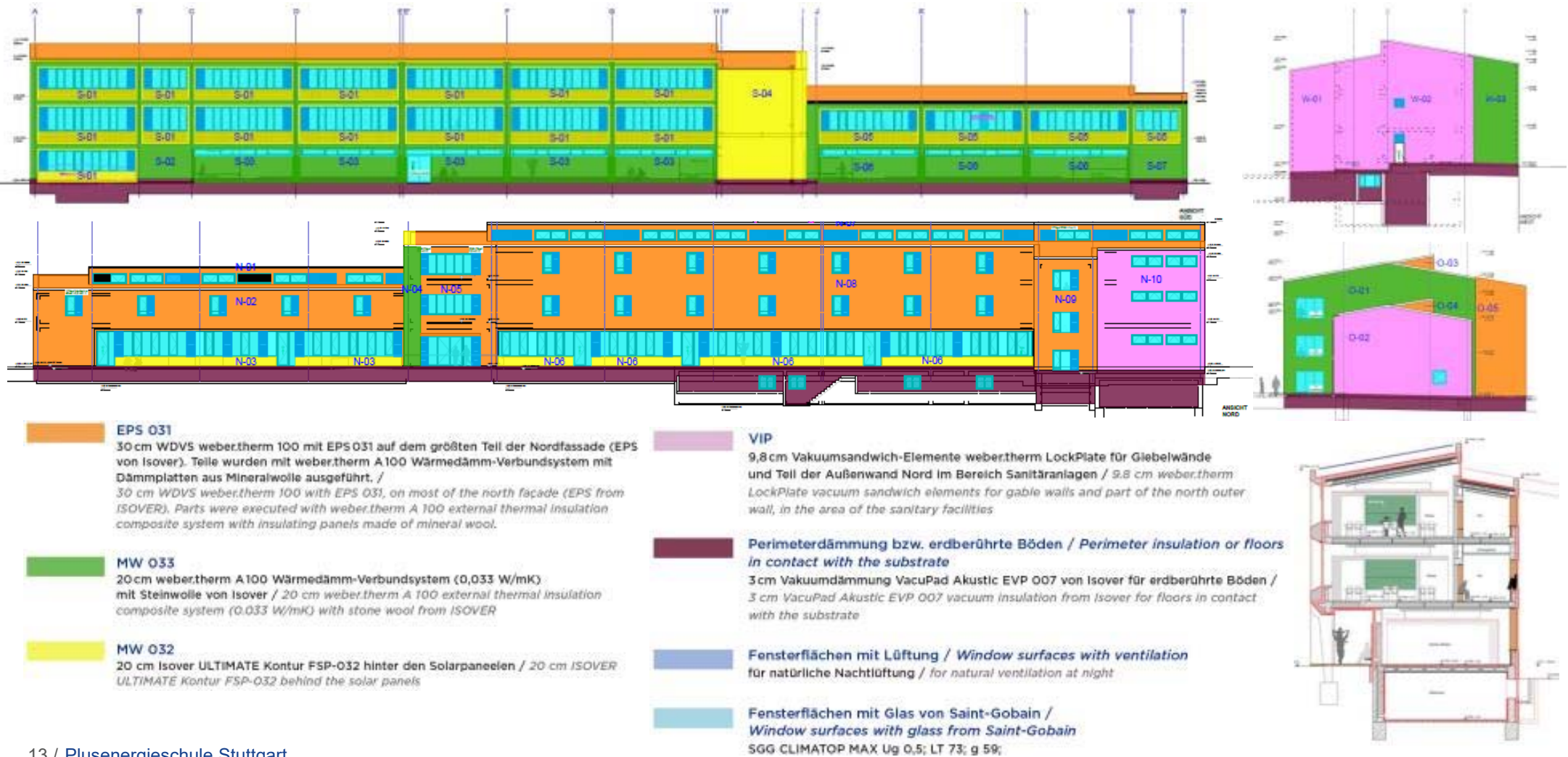
Fassadendämmung zur Energie-
effizienz / *Façade insulation for
energy efficiency*



Geothermie / *geothermal energy*
Keine fossilen Energieträger /
No fossil-based sources of energy



DIE THERMISCHE HÜLLE THE THERMAL ENVELOPE





WÄRMEDÄMMUNG THERMAL INSULATION



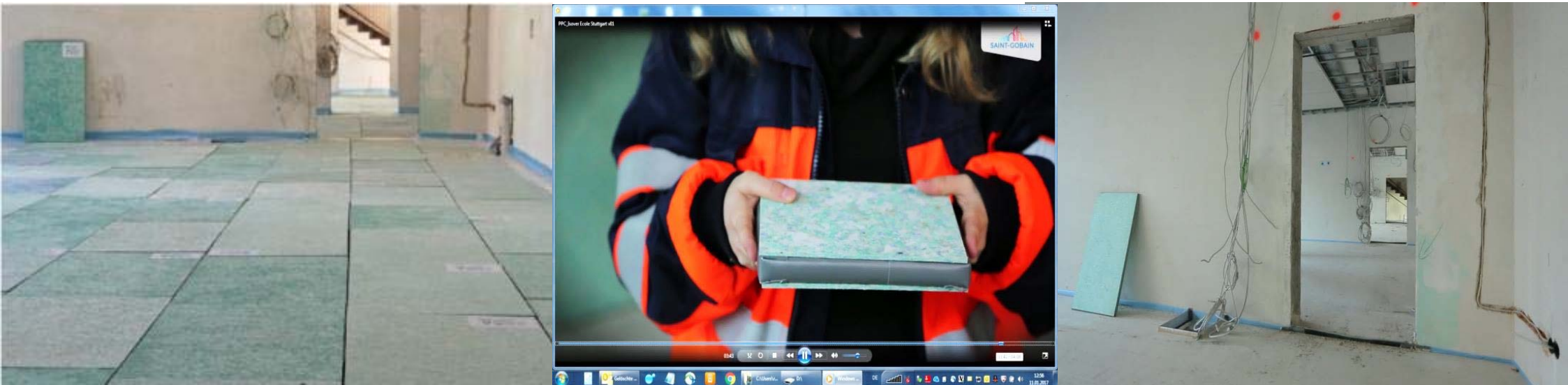


WÄRMEDÄMMUNG THERMAL INSULATION





LÖSUNGEN ISOVER VACUPAD AKUSTIC EVP 007 SOLUTIONS ISOVER VACUPAD AKUSTIC EVP 007



Erdberührter Boden / Floor in contact with the substrate:

- 3 cm Vakuumdämmung VacuPad Akustic EVP 007 von Isover/
- 3 cm vacuum insulation VacuPad Akustic EVP 007 from Isover



THE THERMAL ENVELOPE

<i>Component</i>	<i>U value</i>		<i>Measure</i>
	<i>before</i>	<i>after</i>	
<i>Outer wall, gable side</i>	<i>1,70</i>	<i>0,17</i>	<i>Additional 9 cm vacuum sandwich element, Weber</i>
<i>Outer wall (except for the ground floor, south)</i>	<i>1,70</i>	<i>0,10</i>	<i>Additional 30 cm thermal insulation, Isover and Weber</i>
<i>Outer wall, ground floor, south</i>	<i>1,70</i>	<i>0,15</i>	<i>Additional 20 cm mineral wool insulation, Isover</i>
<i>Parapet, upper floor, south</i>	<i>3,00</i>	<i>0,15</i>	<i>Additional 20 cm mineral wool insulation, Isover</i>
<i>Window classrooms</i>	<i>2,70</i>	<i>0.80</i>	<i>Three-paned Diamant glass with passive house</i>
<i>Window staircases</i>	<i>5,20</i>	<i>0.80</i>	<i>frame, glass from Saint-Gobain</i>
<i>Roof</i>	<i>1,60</i>	<i>0,10/0,15</i>	<i>Additional 30 cm EPS insulation / 9 cm vacuum insulation + EPS insulation, Isover</i>
<i>Floor / ceiling against ambient air</i>	<i>0,80</i>	<i>0,25</i>	<i>Additional 12 cm mineral wool insulation, Isover</i>
<i>Ceiling of the unheated cellar</i>	<i>1,80</i>	<i>0,20</i>	<i>Additional 14 cm mineral wool insulation, Isover</i>
<i>Floor against substrate</i>	<i>3,10</i>	<i>0,47</i>	<i>Additional 3 cm vacuum insulation, Isover</i>



INNENAUSBAU DRY LINING

Trockenbau und Schallschutz / *Dry construction and soundproofing:*

- Isover ULTIMATE Trennwandfilz-040 im Innenausbau
- *Isover ULTIMATE Trennwandfilz-040 in the interior construction,*





INNENAUSBAU DRY LINING



Trockenbau und Schallschutz / Dry construction and soundproofing:

- Isover ULTIMATE Trennwandfilz-040 im Innenausbau
- *Isover ULTIMATE Trennwandfilz-040 in the interior construction,*

BELICHTUNG SAINT-GOBAIN DREISCHEIBEN-DIAMANT-GLAS NATURAL LIGHT SAINT-GOBAIN THREE-PANEL DIAMANT GLASS



Südfassade / South façade:

- SGG CLIMATOP MAX Ug 0,5; LT 73; g 59;
- 6 - 12 Kr - 4 - 12 Kr – 6



Nordfassade / North façade:

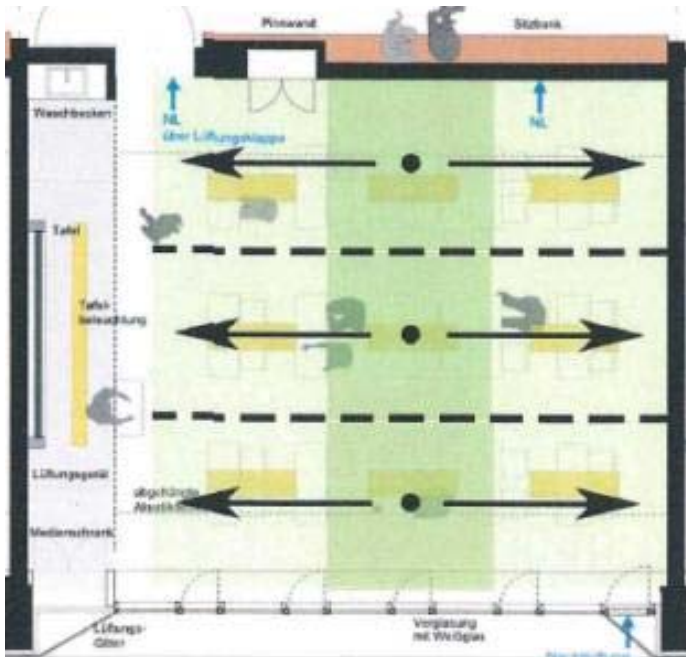
- SGG CLIMATOP MAX Ug 0,5; LT 73; g 59;
- 6 - 12 Kr - 4 - 12 Kr - VSG 33.1



BELEUCHTUNG ARTIFICIAL LIGHT

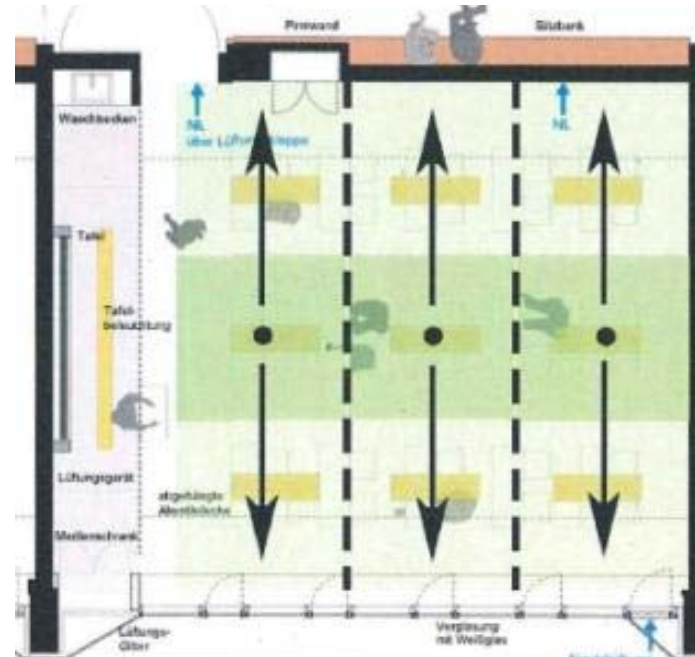
Sensorik für Lichtmanagement / *Sensors for light management*

Lichtfühler zur tageslichtabhängigen Kunstlichtsteuerung
Light sensors to control artificial light, depending on daylight



Sensorik für Lichtmanagement / *Sensors for light management*

Präsenzmelder zur präsenzabhängigen Steuerung
Presence detectors for operation depending on presence





BELEUCHTUNG ARTIFICIAL LIGHT





BELEUCHTUNG ARTIFICIAL LIGHT



CO2

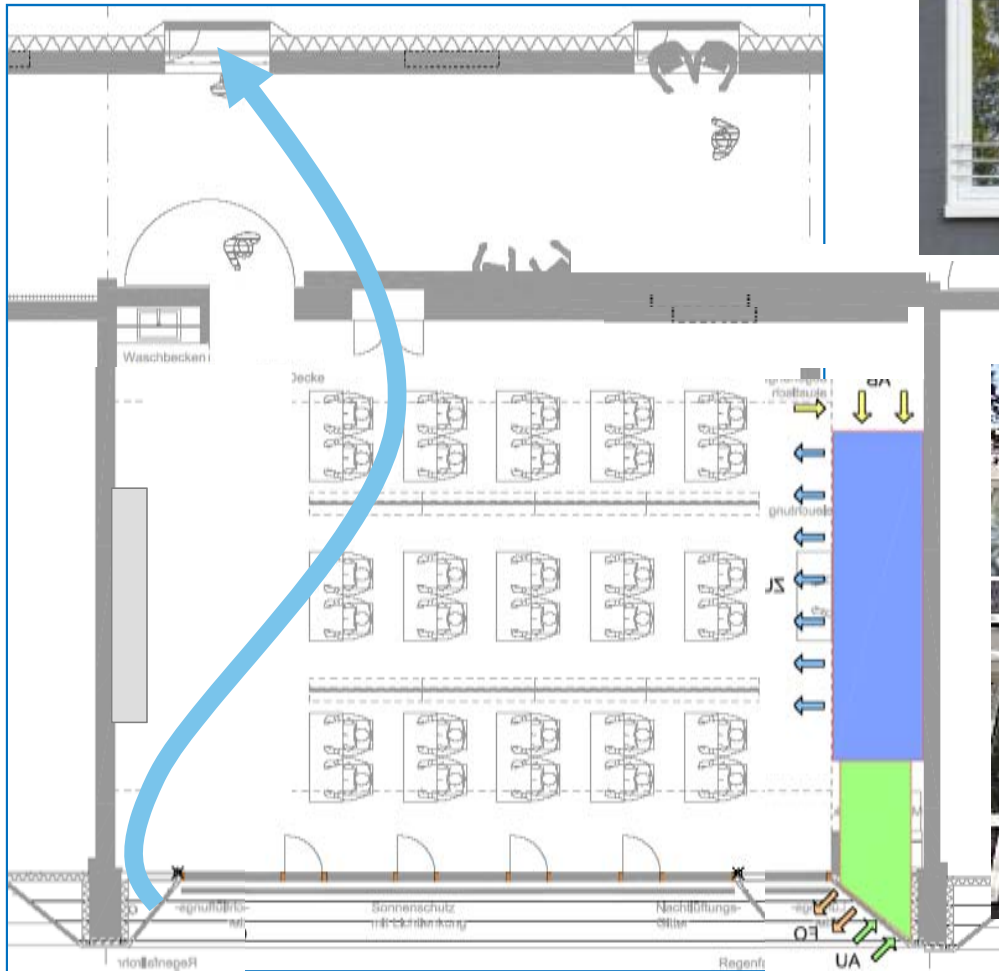




BELÜFTUNG UND KÜHLUNG VENTILATION AND COOLING



BELÜFTUNG UND KÜHLUNG VENTILATION AND COOLING



GEOHERMIE FÜR HEIZUNG

GEOHERMIC FOR HEATING



**PHOTOVOLTAIK 1.800 m² UND ERBRINGT EINE LEISTUNG VON 220 kWp.
PHOTOVOLTAIC 1,800 m² AND GENERATES AN OUTPUT OF 220 kWp**





PHOTOVOLTAIK PHOTOVOLTAIC





AFTER RENOVATION



- Insulation: roof 20 cm, outer wall 10-30 cm,
- Floor / Roof Vacuum Insulation Panels (VIP), EPS
- Heat generation: Heat pump with 52 geothermal probes with 90 m depth
- Heat transfer: low-temperature surface heating system temperatures of 45 °C / 35 °C (TVL / TRL)
- Power generation: Photovoltaic with 220 kWp (1.800m²)
- Hybrid ventilation: ventilation system with 90% heat recovery
- Efficient lighting system: Daylight-dependent control and presence detector
- No refrigeration for cooling purposes (exception: server room)





VOR- UND NACH DER SANIERUNG BEFORE AND AFTER RENOVATION

ISOVER
SAINT-GOBAIN

Rigips
SAINT-GOBAIN

weber
SAINT-GOBAIN

GLASSOLUTIONS
SAINT-GOBAIN



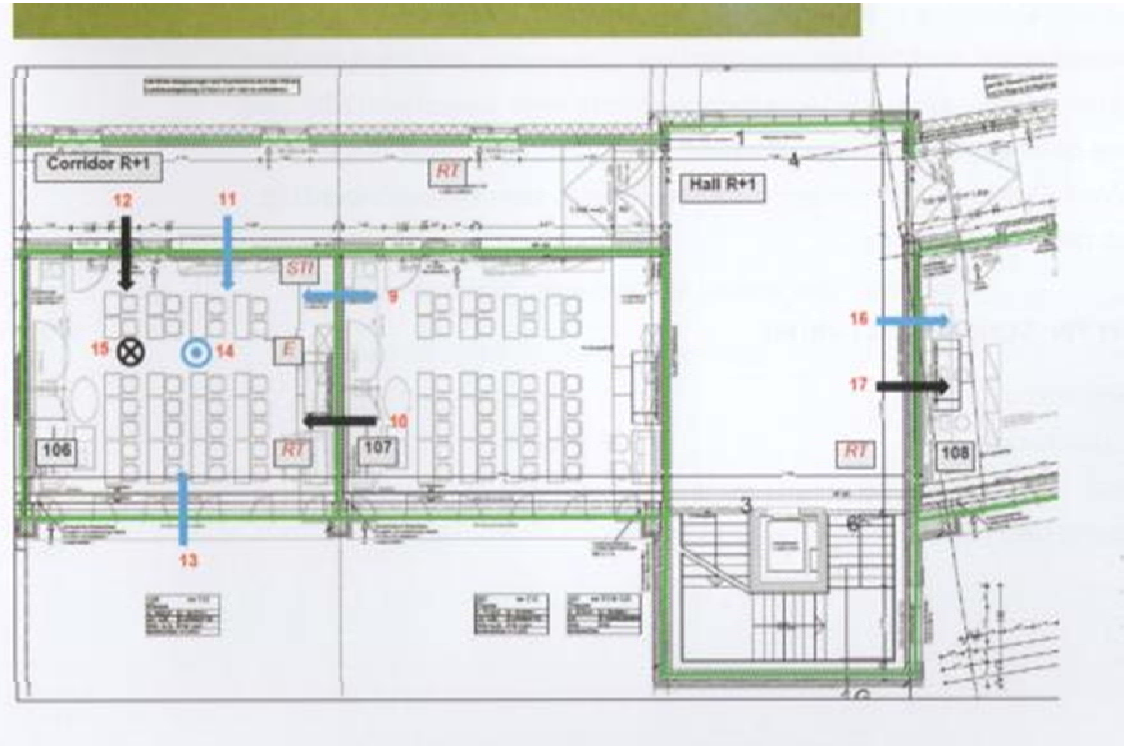
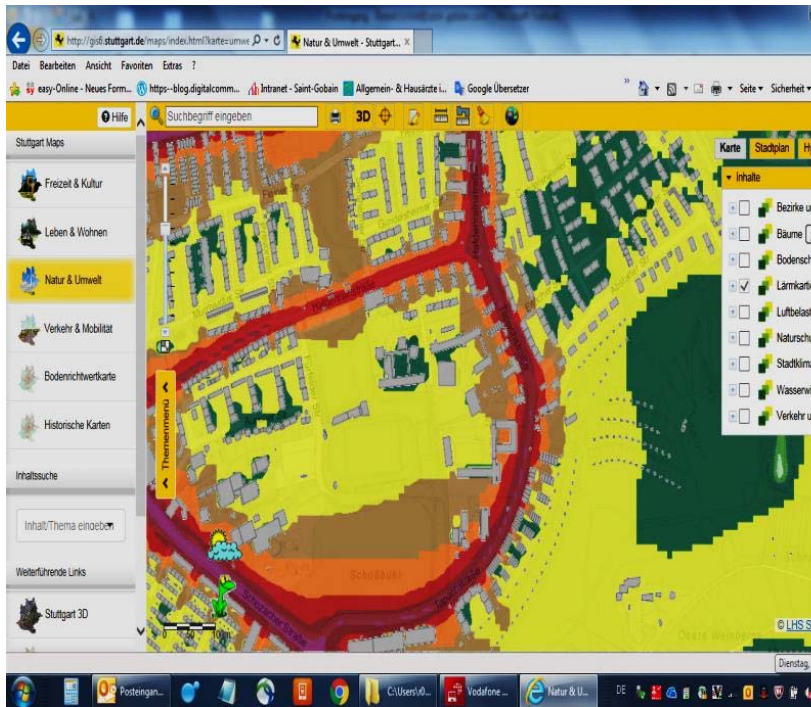


NACH DER SANIERUNG AFTER RENOVATION



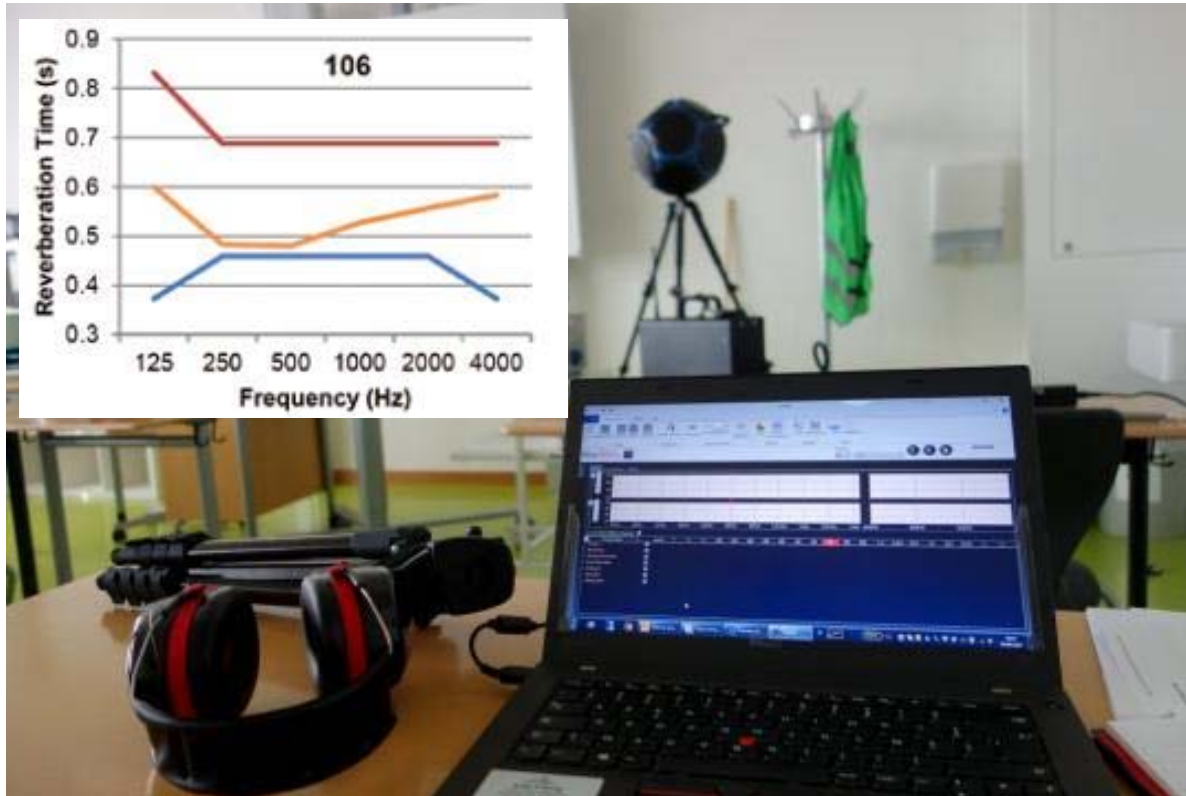
SCHALLSCHUTZ & RAUMAKUSTIK

NOISE CONTROL & ROOM ACOUSTICS



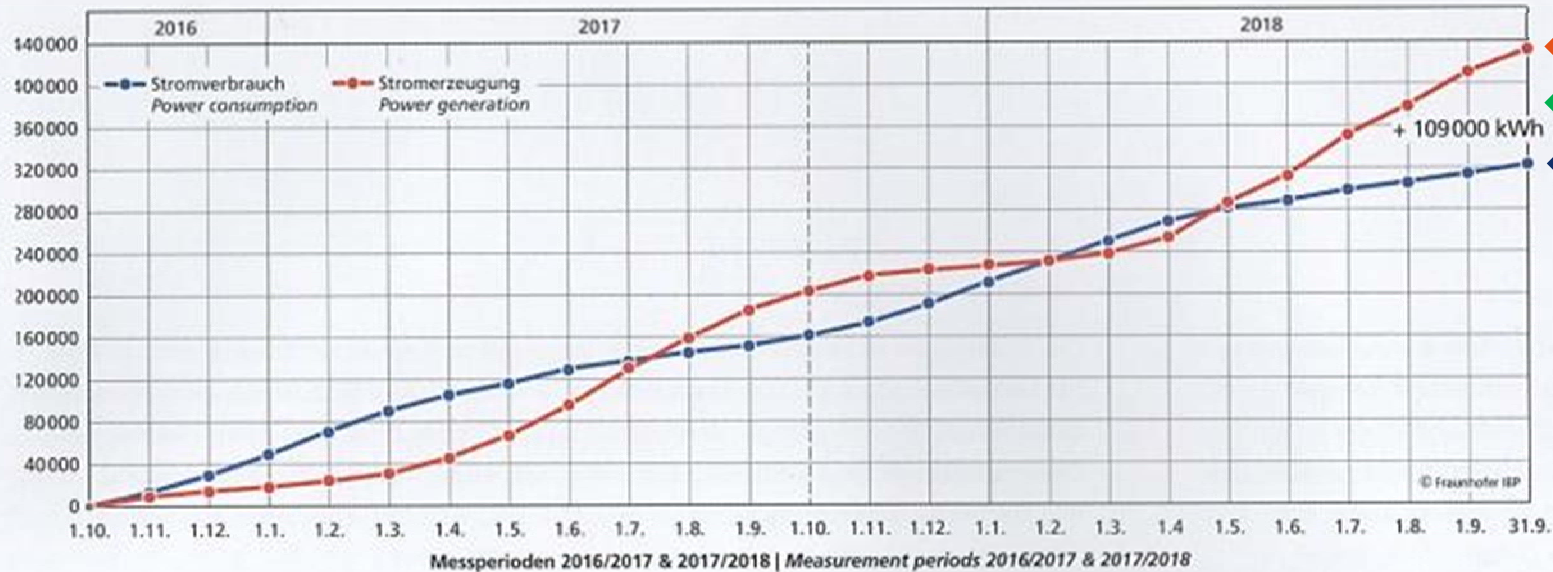
SCHALLMESSUNGEN AM GEBÄUDE 2017

ACOUSTIC IN SITU MEASUREMENTS PLUS-ENERGY-SCHOOL STUTTGART 2017



SGR: Oliver Samin, Marina Malgrange

KUMULIERTE STROMERZEUGUNG UND VERBRAUCH CUMULATED POWER PRODUCTION AND CONSUMPTION



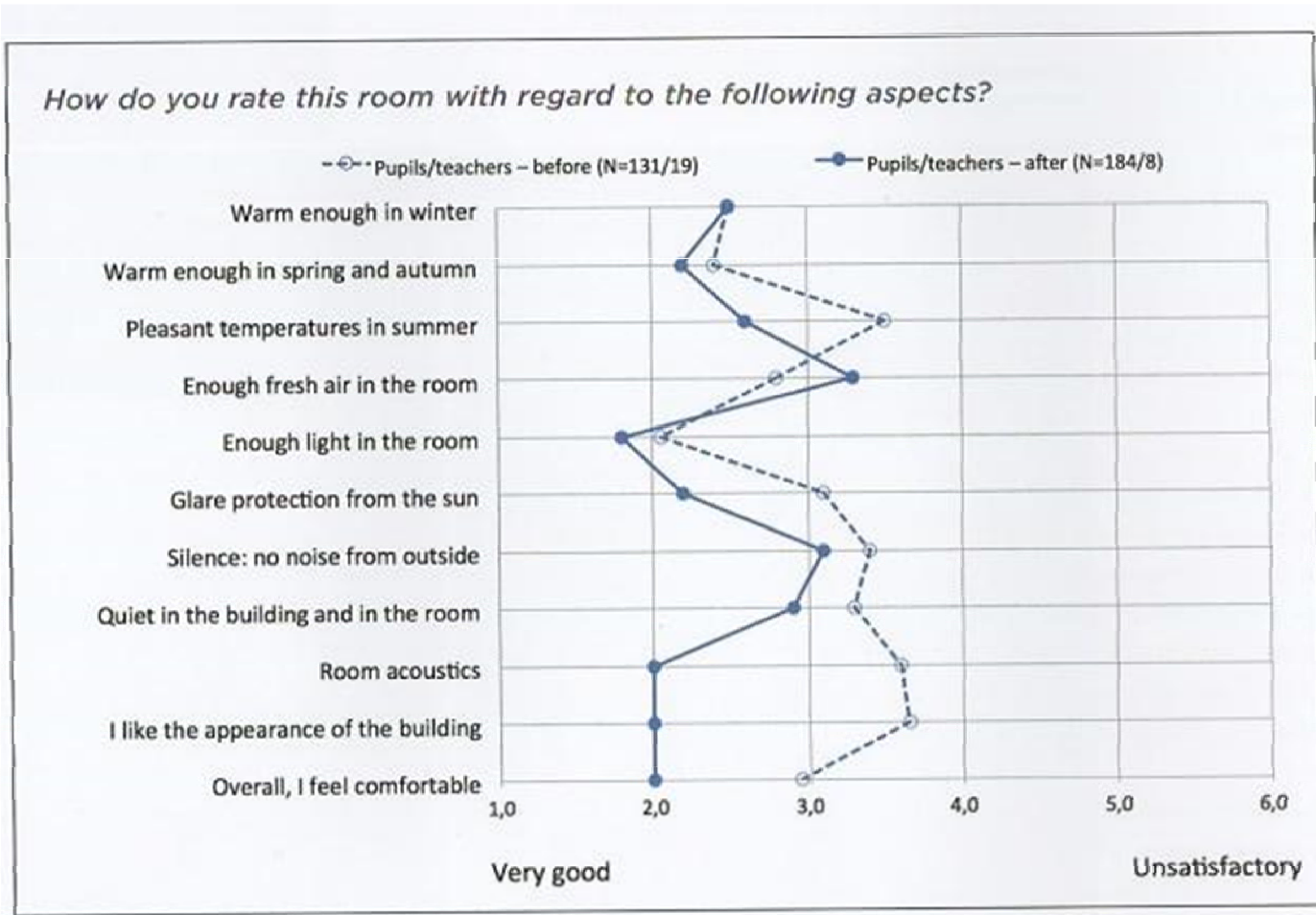
429,000 kWh PV-production

109,000 kWh Surplus

320,000 kWh Consumption



NUTZERZUFRIEDENHEIT / USER SATISFACTION OVERALL IMPROVED SATISFACTION



FEIERLICHE ERÖFFNUNG AM 14. JULI 2017
OPENING CEREMONY 14TH OF JULY 2017

