



**When design meets functionality -
BIPV in a zero energy building**

When design meets functionality - BIPV in a zero energy building

- Background **a2-solar**
- General remarks to BIPV
- Project NVZ Freiburg
- Summary

- **25 years experience in BIPV**
- **References in building and automotive applications**
- **Design, development and production of solar modules and solar systems**
- **Production only in Erfurt, Germany**
- **Flat, cylindrical and spherical bended solar modules**
- **BIPV for small and big projects : wintergarden - skyscraper facade**
- **Certified according DIN ISO 9001**

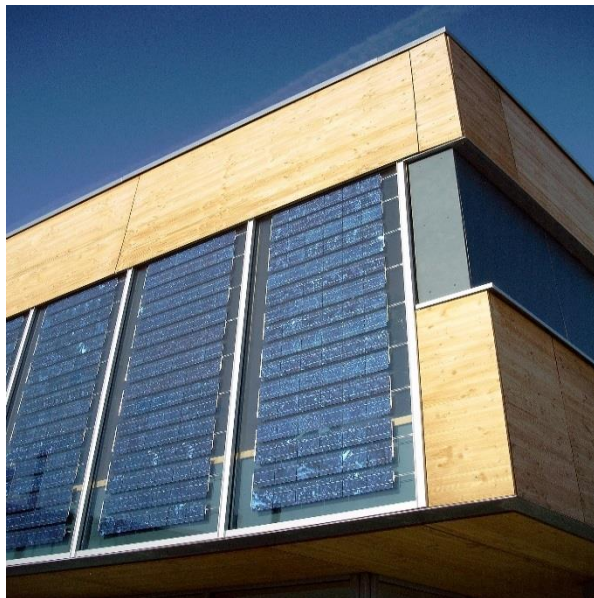
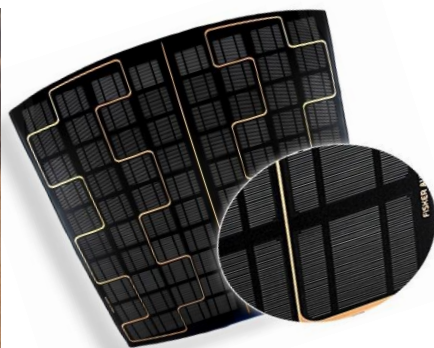


Photo : T.Röder

Product-portfolio **a2-solar** :

Photovoltaic modules for :

- Buildings (BIPV)
- Cars
- Special applications
- Replica of non available standard modules

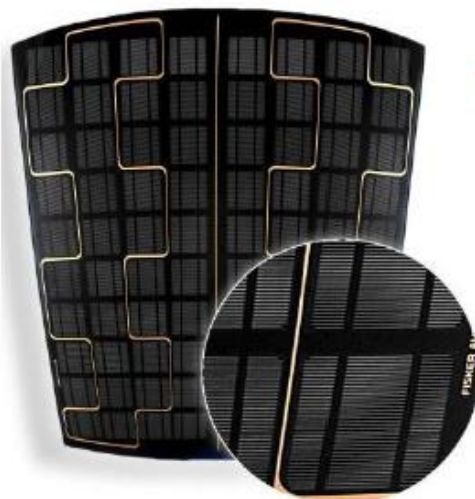


KARMA

- old Fisker KARMA

(SOP in 2011)

120W



- new KARMA Revero

(SOP in 2016)

200W



Definition BIPV according to regulation EN 50583 :

- In addition to the energy production BIPV-elements enable supplement functions in the building :

Weather protection, sun protection, noise protection

- By dismounting BIPV-elements these functions will vanish
- Applications :
 - *facades*
 - *roofs*
 - *overhead applications in wintergardens, terraces, carports*
 - *.....*

BIPV today :

- Niche market
- High-end product in the building market
- Approved technologies from the glass industry
- Green image for building owners and ecological / sustainable „show“ presented by architects
- Expensive
- **Energy production : nice-to-have**

BIPV in future :

- European regulations for zero-emission-buildings from 2021 on
- **Energy production : must-have**

Applications :

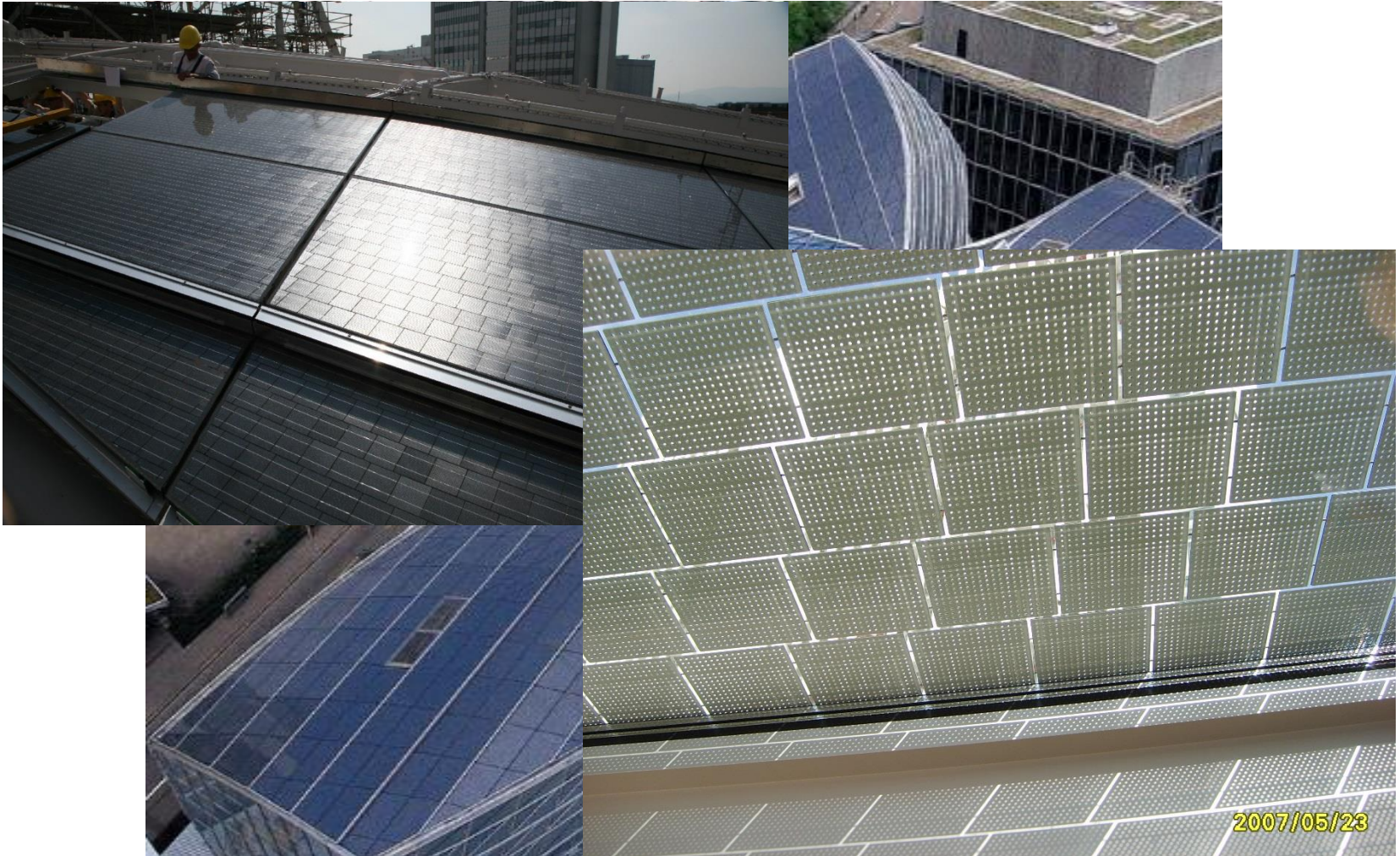


.... strange



.... thoughtless

.... Expensive : Novartis Head-Quarter, Basel by Frank Gehry



PV-elements as double glazed units in a warm facade



Photo : T.Röder



Photo : T.Röder

Punctiform mounted modules in a second-skin facade

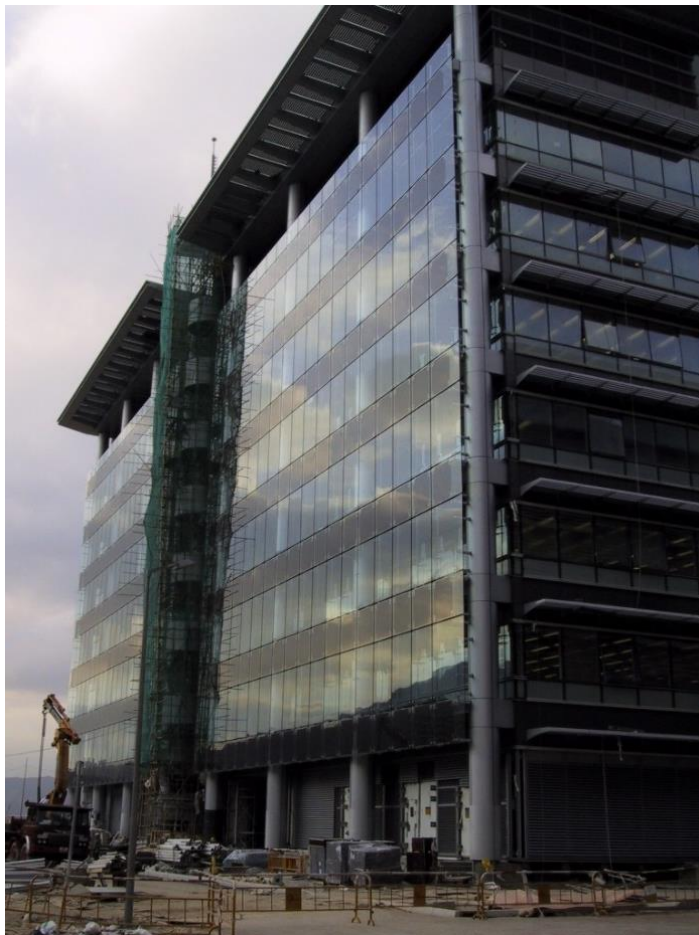


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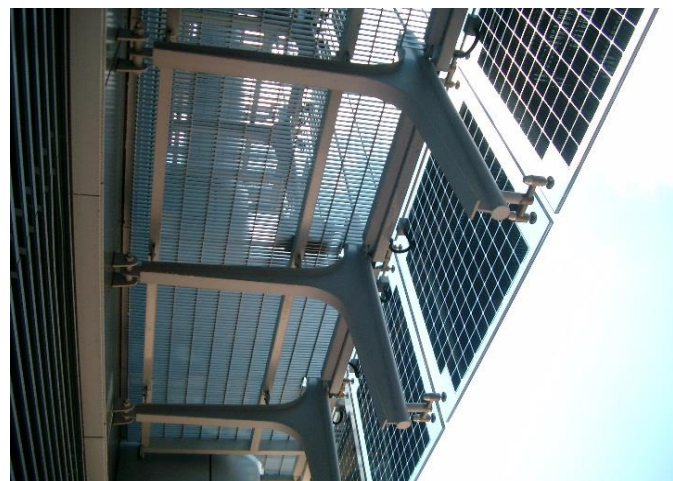


Photo : T.Röder

Landmarks Porsche Pylon Berlin

Modules mounted in a
structural glazing
construction



Photo : a2-solar

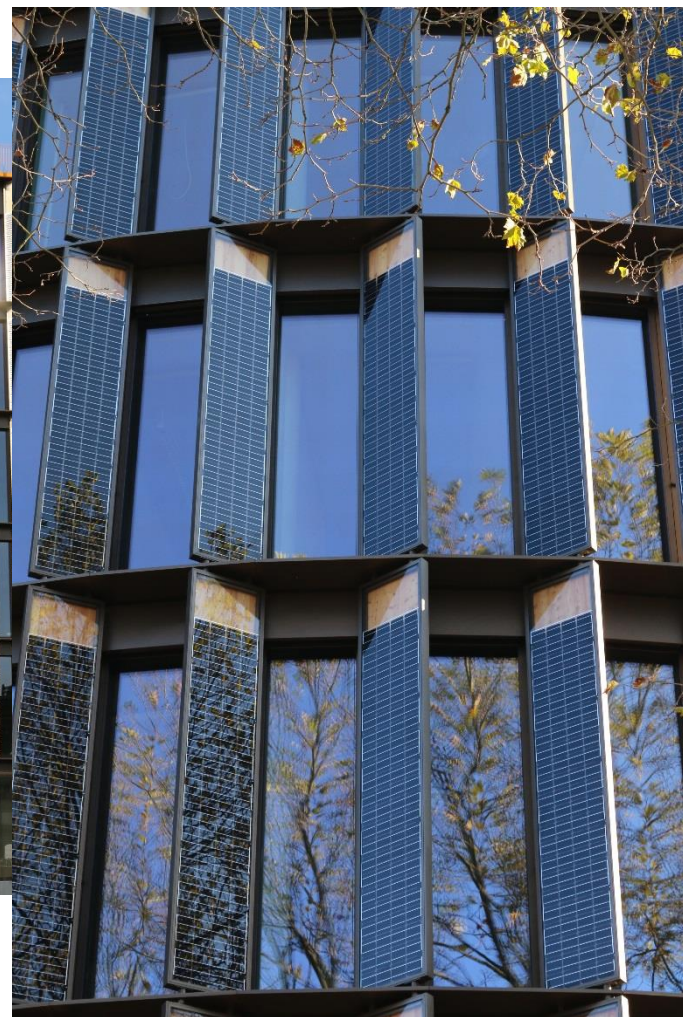


Photo : a2-solar

New Technical Major House (NVZ) in Freiburg, Germany



Photo : a2-solar



General data :

Architects :	Ingenhoven & Partner, Düsseldorf
Curtain-wall :	HW Würfel Metallbau, Sontra
Electrical planning :	DS-Plan, Stuttgart
Solar modules :	a2-solar, Erfurt

Conception : Plus-Energy-Building

- Heating / Cooling by ground water and heat pump
- PV installations on facade (220 kWp) and roof (500 kWp)

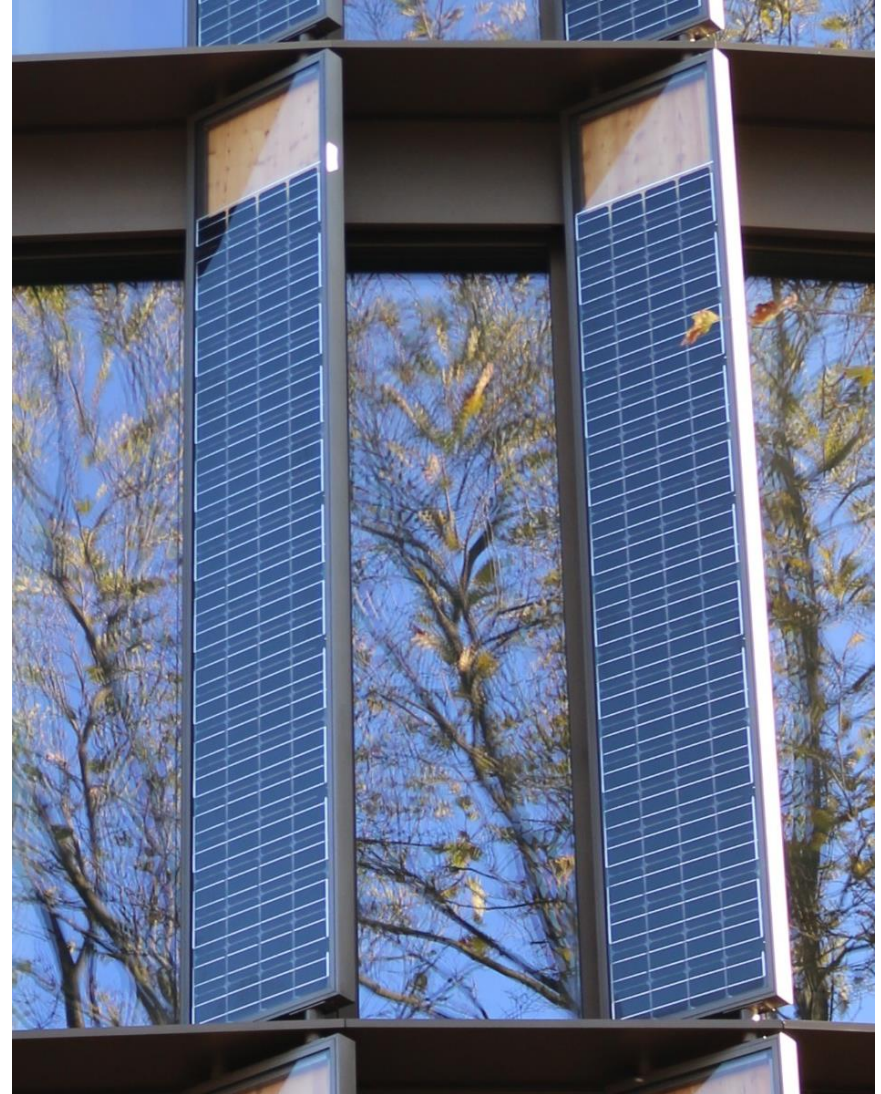
⇒ **Facade build of semitransparent solar panels combined with timber as sun protection for the offices**

Modules :

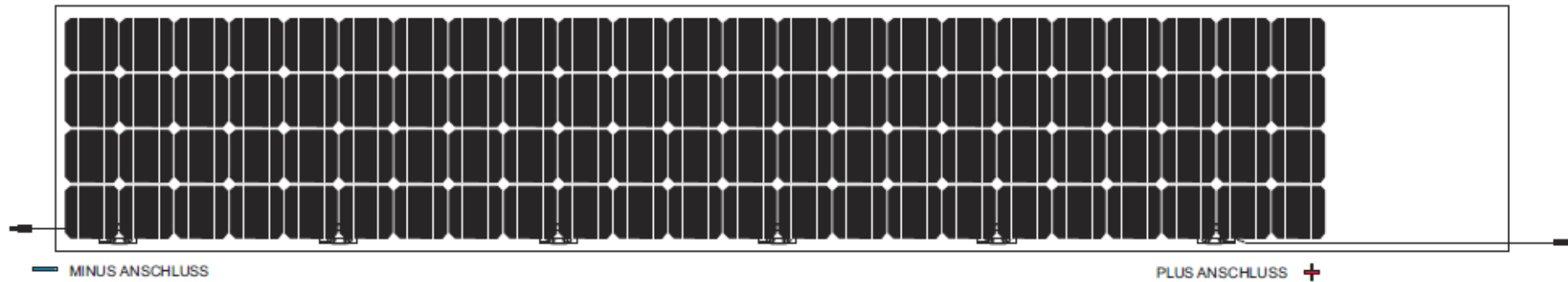
Number : 880
Square : 1800 m²

Size : 0,6 m x 3,5 m
Power : 245 Wp
Layout : 2 x 5 mm tempered glass
Cells : 5" monocrystalline

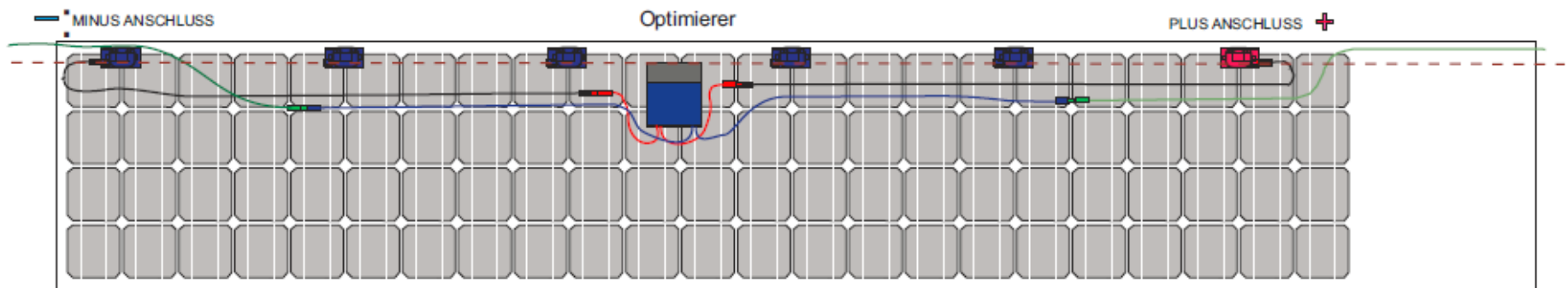
- Mounted in a steel frame with a backside timber in 50 mm distance
- Ventilated space between module and timber
- Fixed orientation



Module front side



Module back side



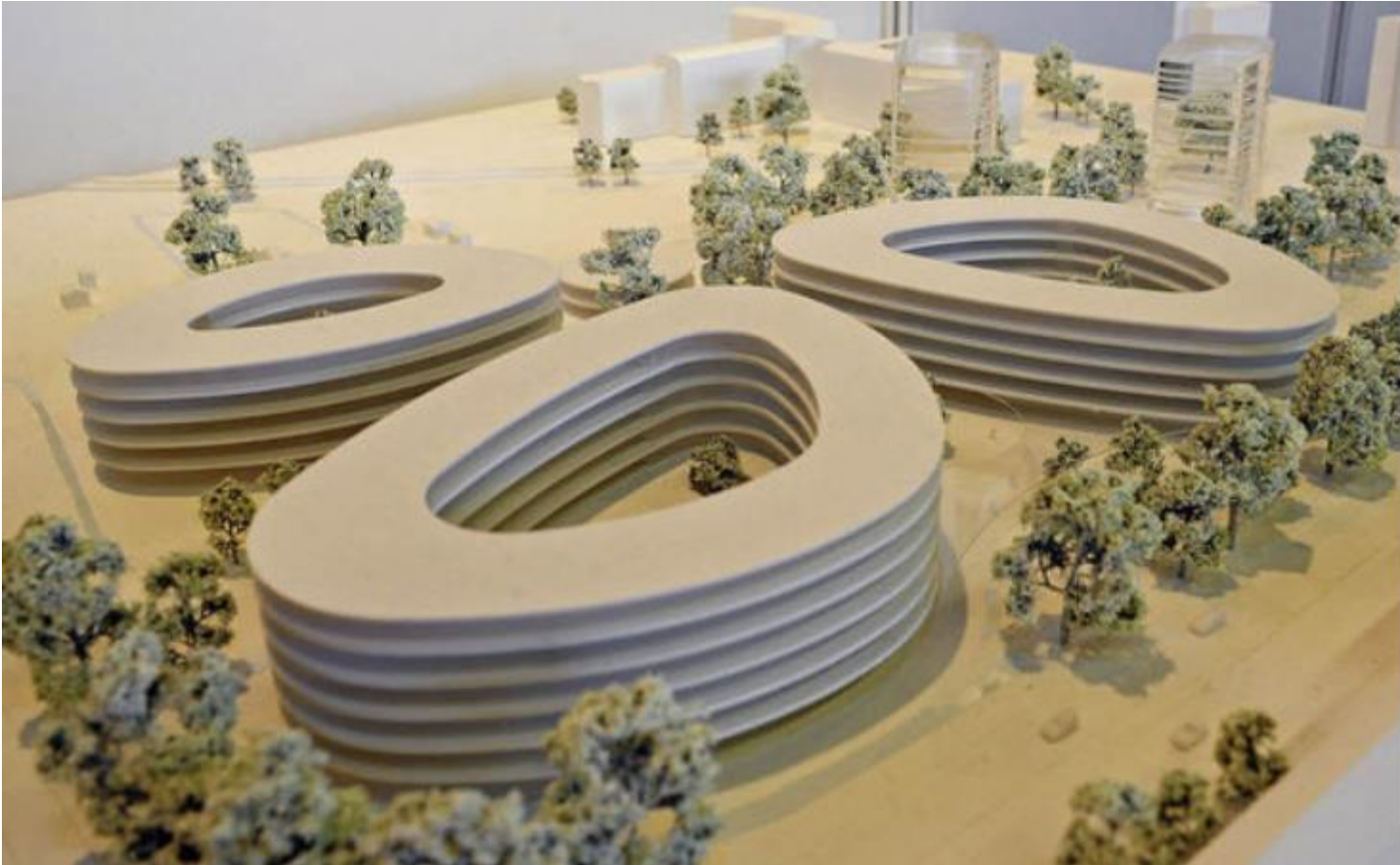
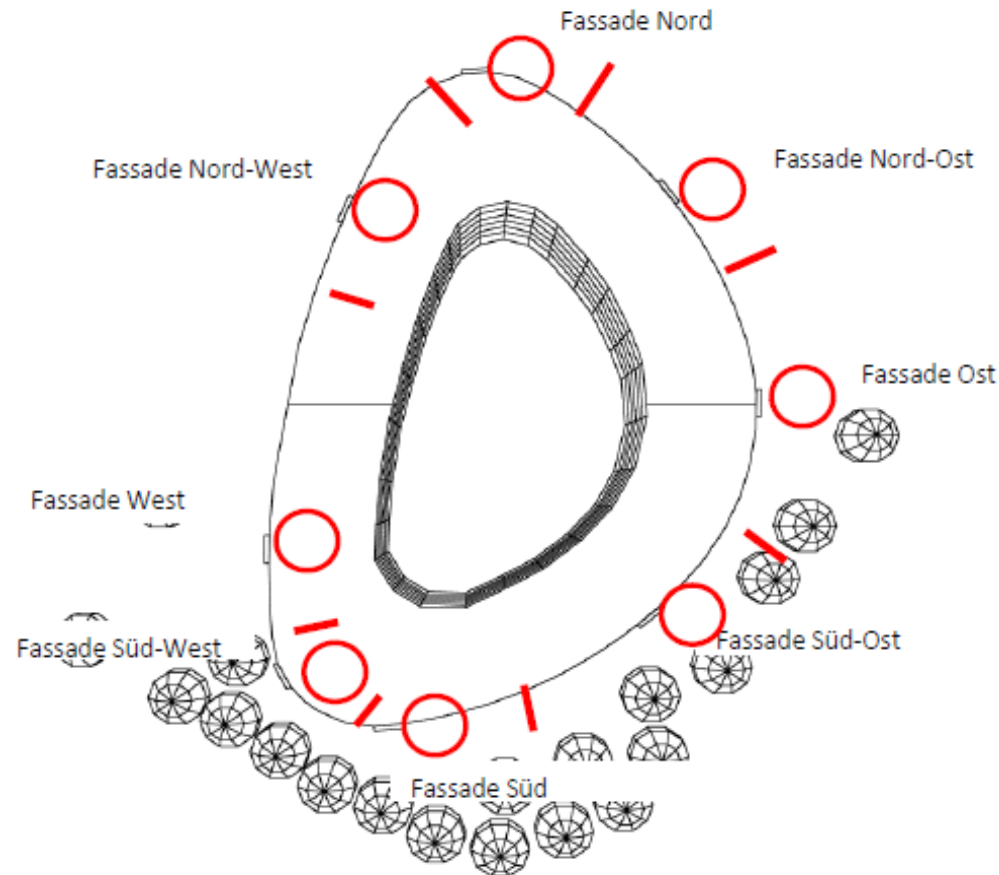
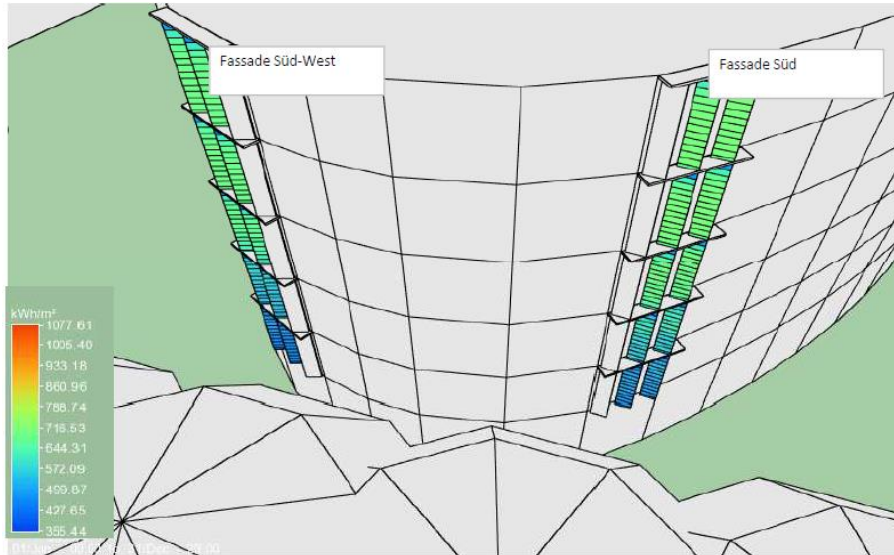


Photo : Ingenhoven Architekten

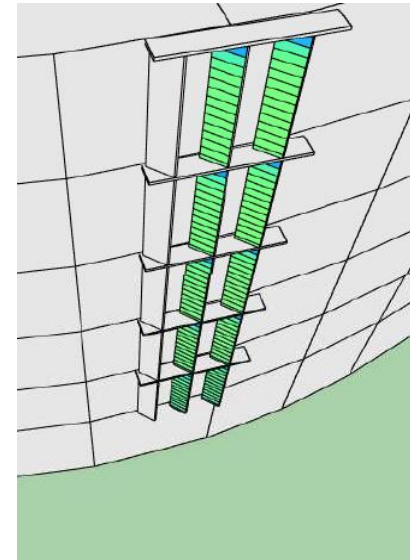
Model NVZ by Ingenhoven Architects



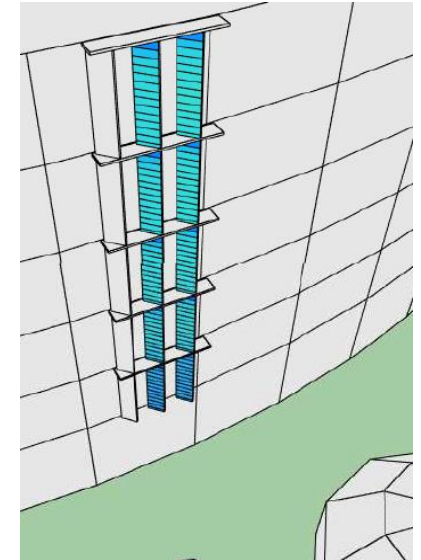
- facade clustered into different units for simulation
- consideration of horizon and skyline



South West



South



South East

East

- **Simulation of the yearly irradiation on facade cluster and floor-level**
- **Different level of radiation depending on time of day**
- **Need for module inverter or optimizer**

Results of the simulation in kWh/m²/a

PV Fassade

Fassaden- ausrichtung		N	NO	O	SO	S	SW	W	NW	Bemerkung
Strahlungsenergie auf PV-Fläche (kwh/m²a)	1.OG	370	505	650	505	505	475	580	480	Werte aus Verschattung / Strahlungssi- mulation
	2.OG	375	550	680	580	570	550	600	525	
	3.OG	380	570	690	680	680	650	625	550	
	4.OG	380	570	695	720	700	680	630	565	
	5.OG	380	570	695	720	700	680	635	565	

- no need for modules in the northern cluster
- big differences between first and fifth level over the year in southern cluster
- „balanced“ results for East/West orientation

Results of the simulation in kWh/a/cluster

Geschoss	NO	O	SO	S	SW	W	NW	SUMME
5	2.986	4.302	4.457	4.667	4.210	3.931	2.960	27.512
4	2.986	4.302	4.457	4.667	4.210	3.900	2.960	27.481
3	2.986	4.271	4.210	4.533	4.024	3.869	2.881	26.774
2	2.881	4.210	3.590	3.800	3.405	3.714	2.750	24.350
1	2.645	4.024	3.126	3.367	2.940	3.590	2.514	22.207

- Total : 128,5 MWh / year by facade „power plant“
- sufficient value in addition to the 500 kWp roof top installation for certificate as „plus-energy-building“
- optimizer or module inverter additional invest

BIPV in the future :

- Requirement for zero-energy buildings acc. to ENEC 2020/2021
- Due to small roof areas facades have to enable the energy production for high buildings / skyscrapers
- The integration of solar application into the facade has to be considered during planning phase of the project
- The portfolio of different glass and facade technologies will allow to use all existent possibilities for the „PV-solution“
- Synthesis of design, efficiency, ecology and regulation
- Acceptable amortisation time for additional solar investment

Thank you for your attention

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