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RENOWAVE
DECARBONIZATION OF THE BUILDINGSTOCK

# BUILDING TYPOLOGY
## Strategy and roadmap for sustainable renovation

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TRANSFORM
Transform Institute
Heritage, Construction and Users

smart living lab

# VISION FOR THE SWISS BUILDING STOCK

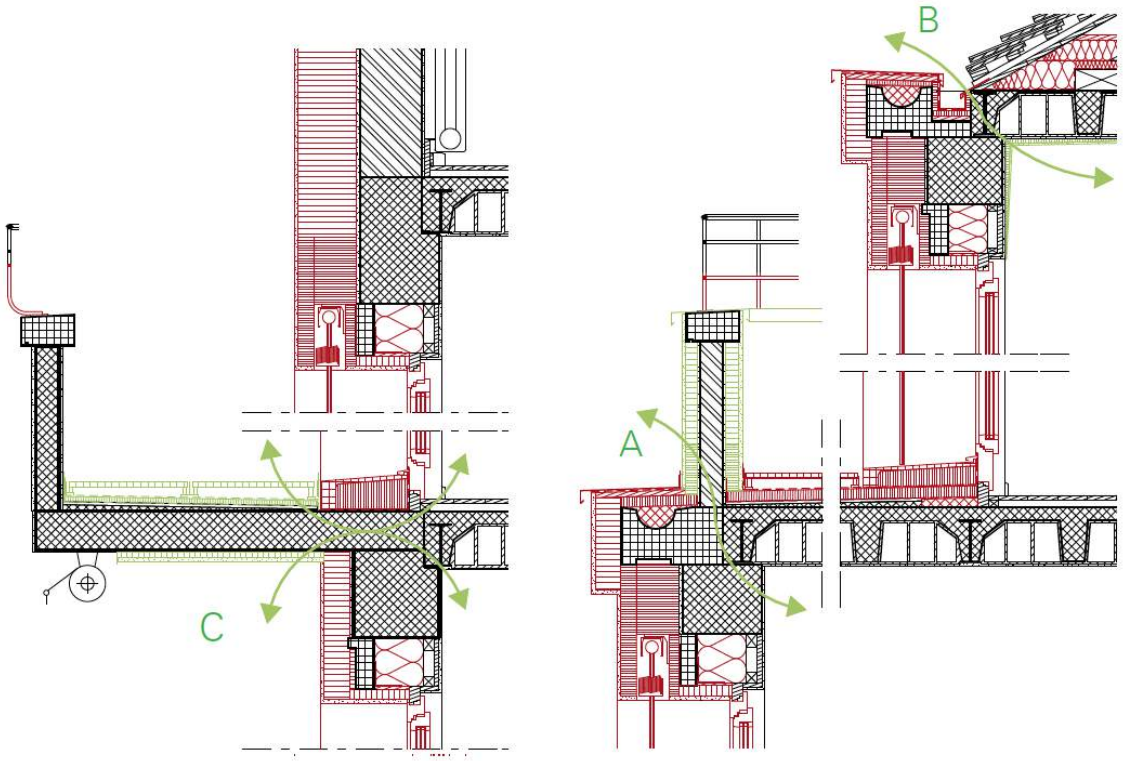
REDUCTION By 2050, the final energy consumption (heat and electricity) of the Swiss building stock is 65 TWh instead of 90 TWh. In the overall consideration of a building, **not only the operating energy should be reduced, but also the gray energy and the gray emissions**.

OPTIMIZATION **By 2050, the energy performance of every building in Switzerland is known.** By 2030, energy operation optimization is mandatory for all buildings.

SUBSTITUTION By 2050, there will be **no more heating oil, natural gas or electricity for direct consumption for heating**. **The majority of buildings will be renovated for energy efficiency.** Petroleum and natural gas heating systems as well as stationary electric resistance heating systems have been replaced by renewable energy sources.

# CHALLENGES AND RISKS

## CONSTRUCTION AND BUILDING PHYSICS

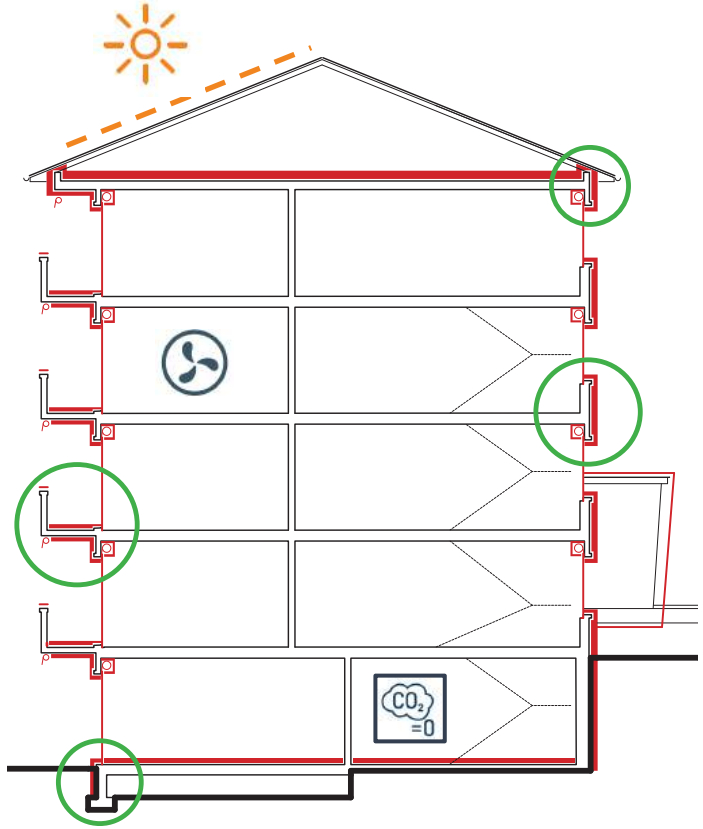



# CHALLENGES AND RISKS

## HERITAGE AND BUILDING CULTURE

# CHALLENGES AND RISKS

## A GLOBAL APPROACH




Which **realistic interventions and methodology** can help increase the renovation rate of buildings, while guaranteeing **quality and sustainability**?

Which **building design typologies** exist and which renovation scenarios are suitable?

# BUILDING TYPOLOGY

eREN_Building models for multi-family buildings in Western Switzerland

# BUILDING TYPOLOGY

## APARTMENT BUILDING_PRE-WAR PERIOD

**Dach**
bewohntes Mansardgeschoss, Mansarddach mit Biberschwanzeindeckung

**Geländer**
schmiedeeisernes Geländer

**Sonnenschutz**
Holzfensterläden

**Balkon**
Betonplatte auf Tragkonsolen aus Naturstein

**Fenstereinfassung**
Naturstein

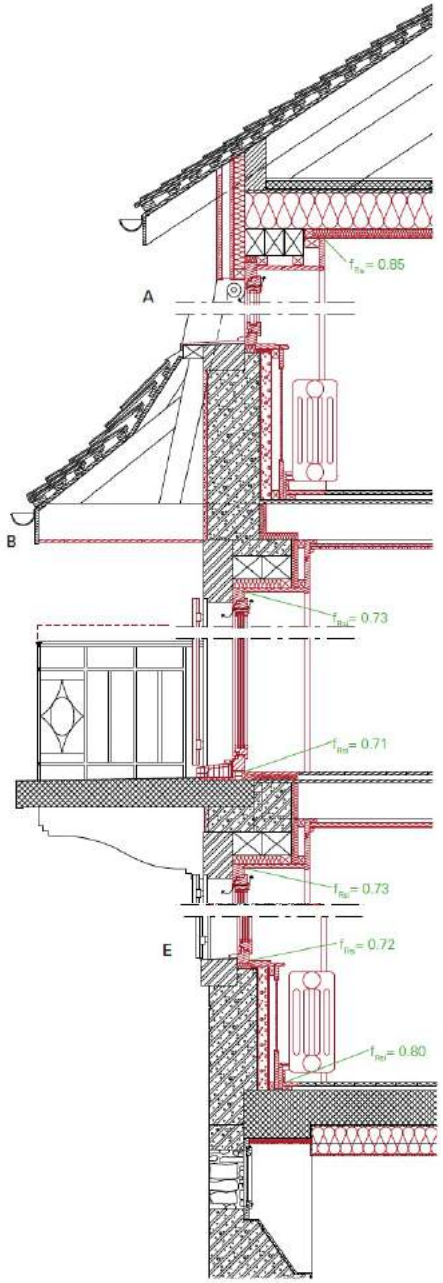
**Geschossdecke**
Holzbalkendecke

**Fenster**
Holzrahmen, Kastenfenster mit Einfachverglasung

**Aussenwand**
verputztes Bruchsteinmauerwerk, 50-60 cm, die Mauerstärke verringert sich in den oberen Geschossen

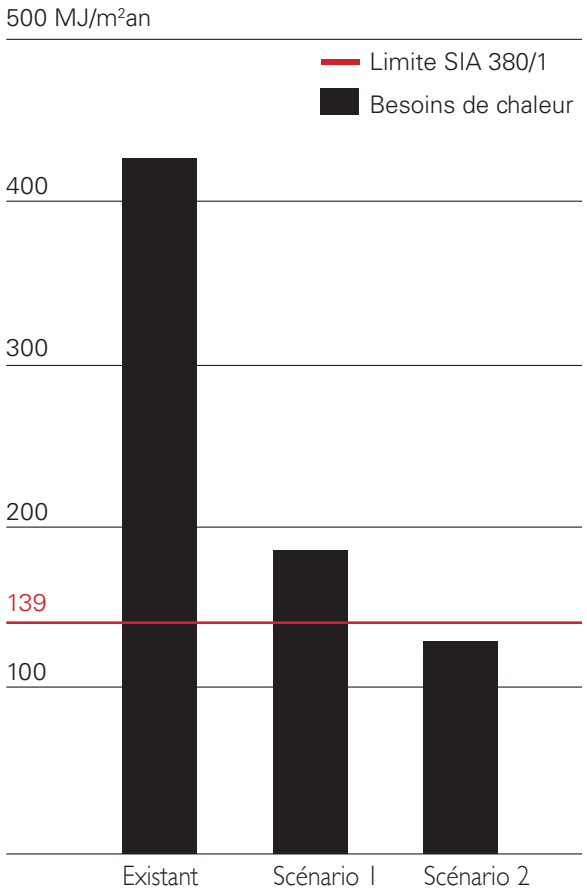
**Sockel**
Mauerwerk, Natursteinverkleidung

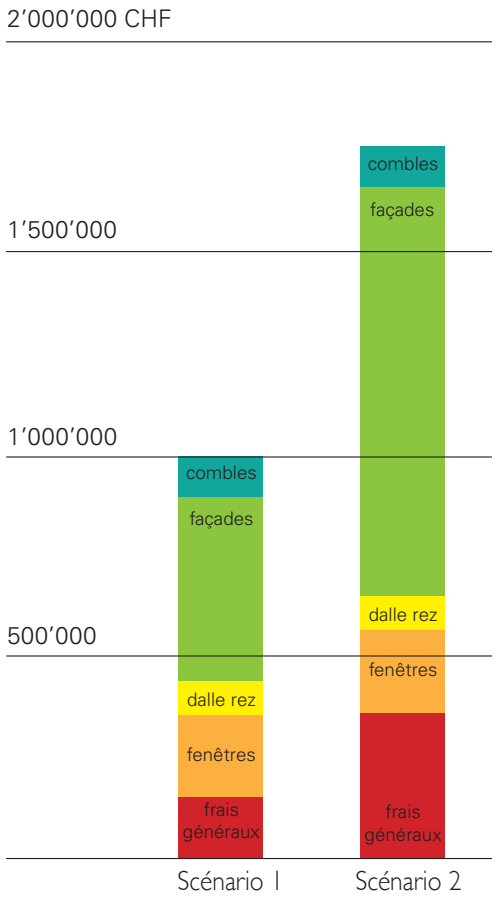
*Ausschnitt der Ostfassade*

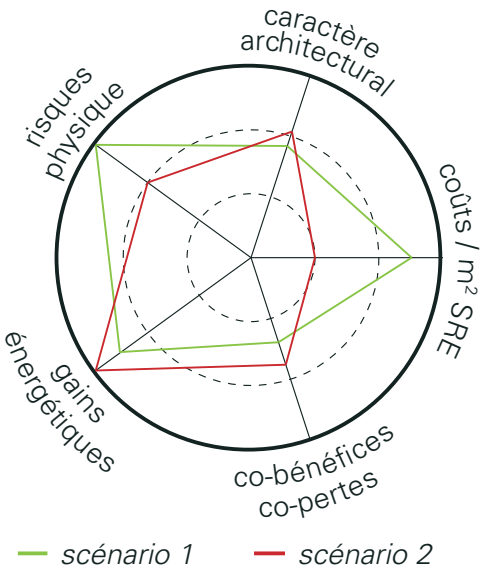


# BUILDING TYPOLOGY

## APARTMENT BUILDING_PRE-WAR PERIOD



# BUILDING TYPOLOGY

## APARTMENT BUILDING_POST-WAR PERIOD

**Dach**
flachgeneigtes Walmdach mit Ziegeleindeckung und Dachüberstand

**Oberste Geschossdecke**
Hourdisdecke

**Fenstereinfassung**
Kunststein

**Geschossdecke**
Hourdisdecke

**Fenster**
Holzrahmen, Doppelverglasung

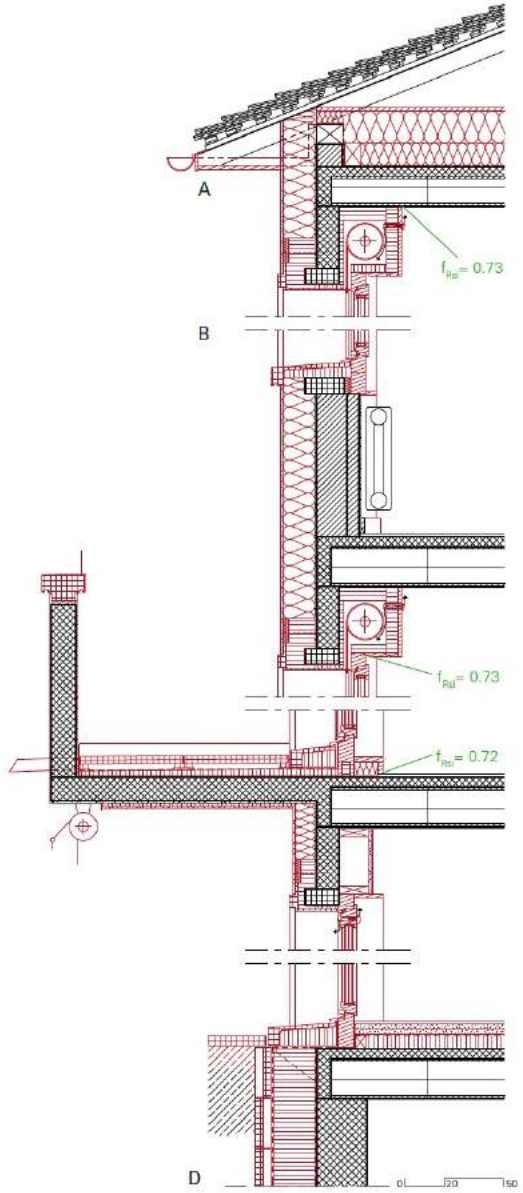
**Sonnenschutz**
Rollstoren mit innenliegendem Storenkasten

**Aussenwand**
Ziegelmauerwerk verputzt mit Luftschicht und innerer Vorsatzschale (ca. 30 cm dick)

**Aussenbereich**
Loggia, leicht auskragend, Betonplatte auf Aussenwänden aufliegend, verputzte Mauerwerksbrüstung

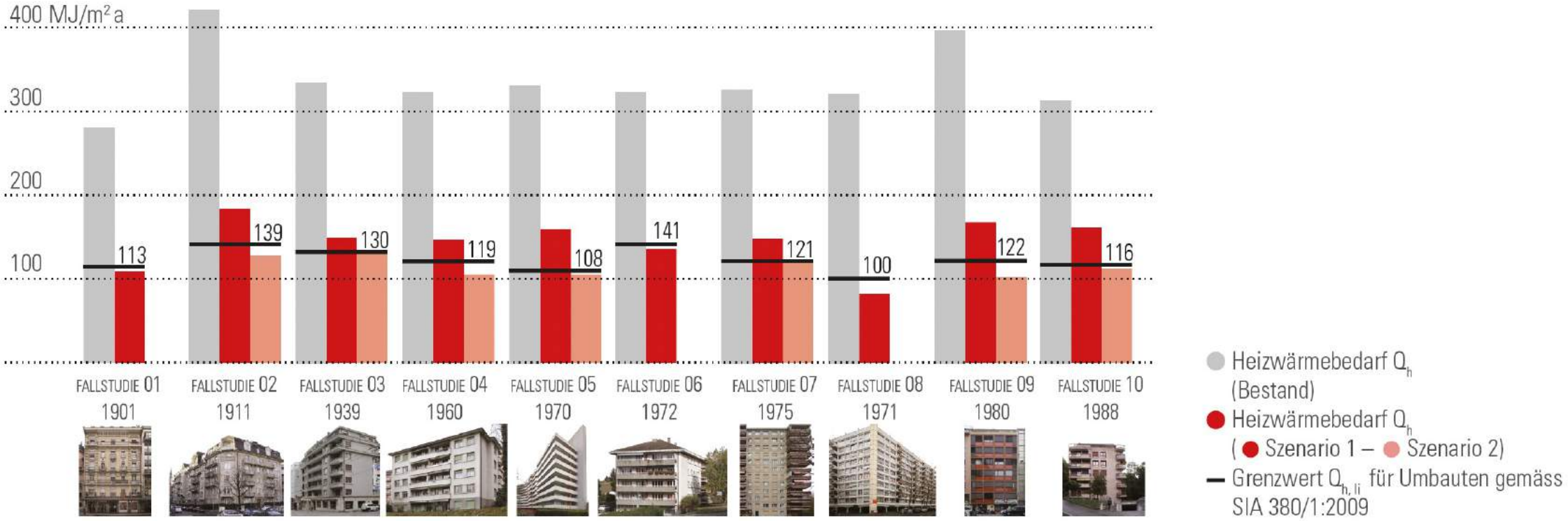
**Decke über Kriechkeller**
Hourdisdecke

*Ausschnitt der Südostfassade*



# HEAT BALANCES

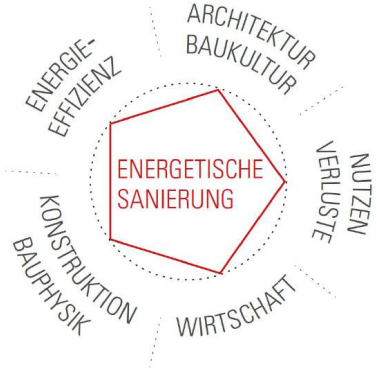
## COMPARISON OF RENOVATION SCENARIOS



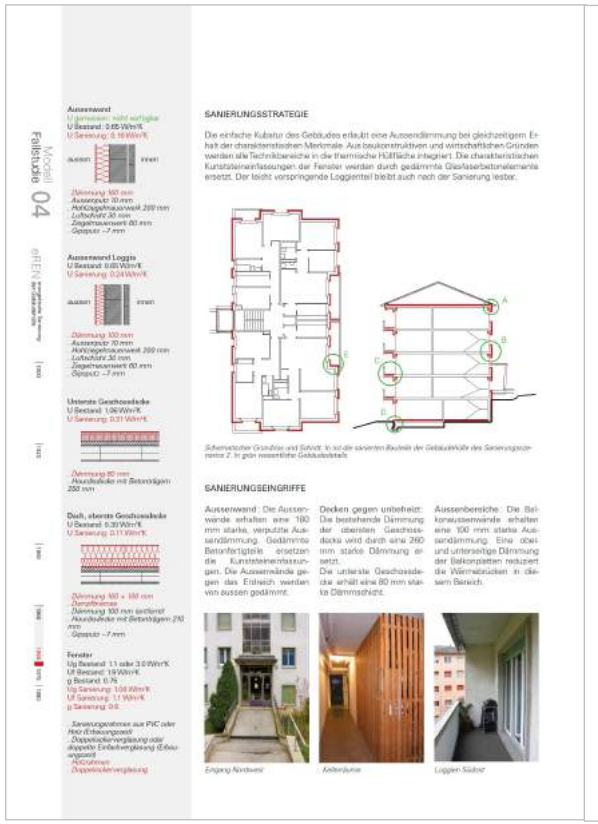
APPROCHE GLOBALE POUR L'ENVELOPPE DU BÂTIMENT
RÉNOVATION ÉNERGÉTIQUE

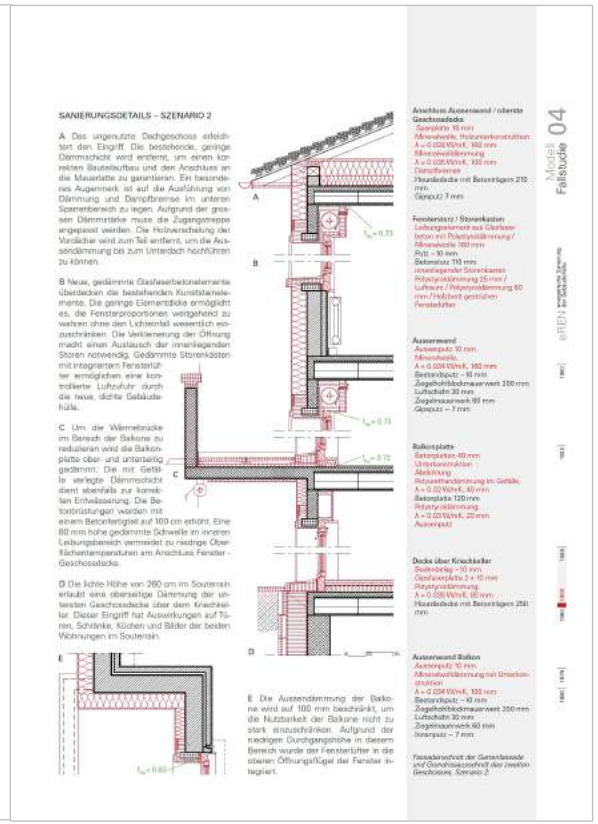
# eREN_Global approach for the envelope

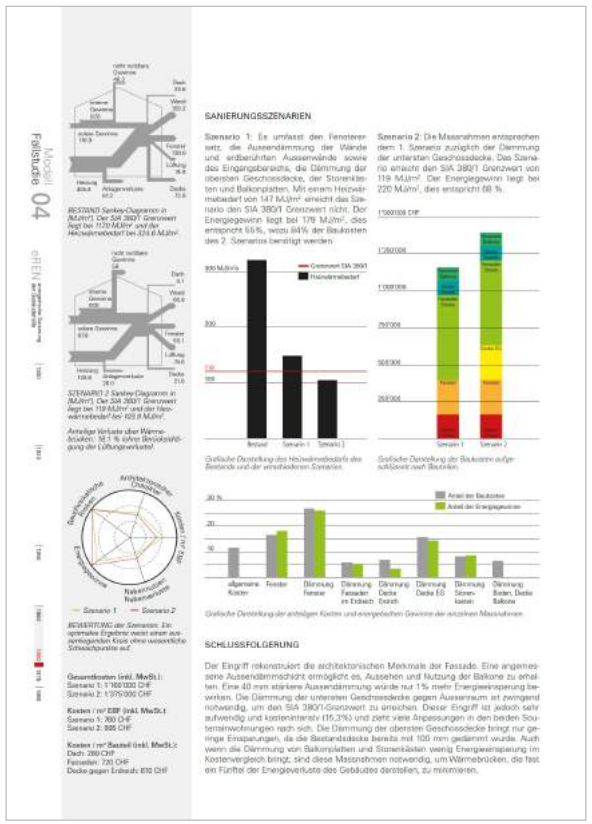
10 typology sheets for representative typologies of 20th century residential buildings




RENO WAVE

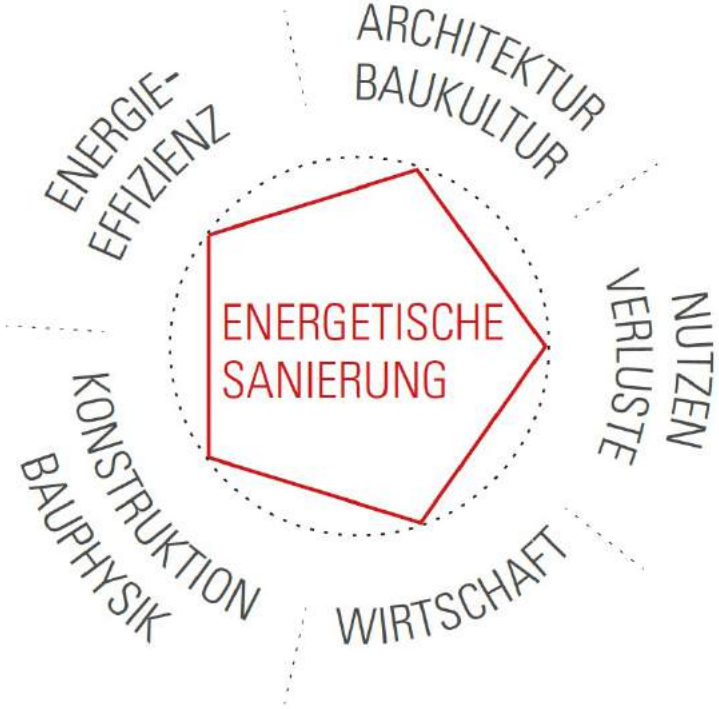



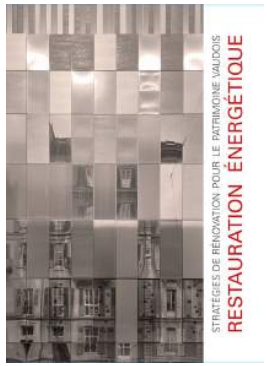



# ROADMAP FOR SUSTAINABLE RENOVATION

TypoRENO-VD, RenoBAT-FR




- Regulations and labels, which until now have focused mainly on new buildings, need to take better account of the specific features and limitations of existing buildings renovation.
- Renovations must be considered as a sustainable optimization process that includes embodied and operational emissions and the time-frame of interventions.
- The global eREN approach is completed by an environmental assessment, an evaluation of the technical installations and the obsolescence of the construction elements.



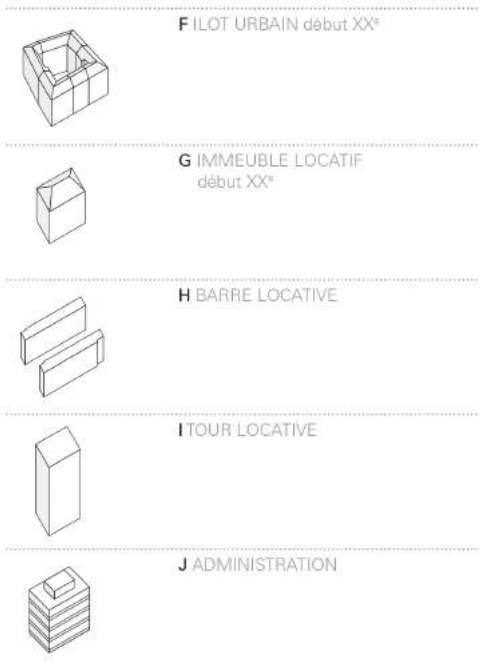

# HERITAGE BUILDINGS

## ENERGY-EFFICIENCY RESTORATION OF HERITAGE BUILDINGS

canton de vaud

The energy-efficiency restoration typology project brings together the heritage and energy departments in a shared vision of good practices to reconcile divergent interests and improve the quality of projects.





# ROADMAP

## STEPWISE RENOVATION MEASURES

- Optimization of heated and unheated spaces, optimization of technical installations
- Insulation of slabs and walls against unheated spaces in communal areas
- Insulation of the external envelope
- Replacement of fossil heating
- Measures inside the flats
- Densification measures (in blue)

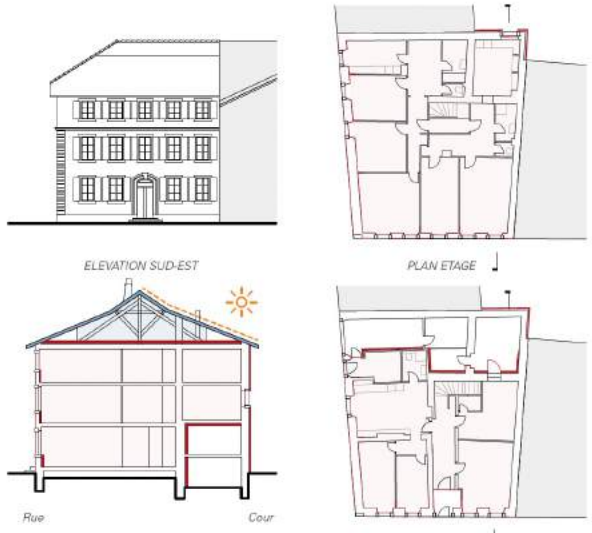
Un crépi isolant permet de garder les nombreux éléments décoratifs sur rue

Une isolation en silicate de calcium est appliquée côté cour

Des tuiles solaires couvrent le pan de toiture côté cour

Les tuiles photovoltaïques s'intègrent dans le site historique

Les ornementations et la porte d'entrée en bois sont préservées




*Plan et coupe schématiques. En rouge, les éléments de l'enveloppe isolés dans le scénario. En bleu, l'étape supplémentaire de la valorisation des combles. En orange, l'intégration des panneaux photovoltaïques. En rose, l'enveloppe thermique*

STRATÉGIE DE RÉNOVATION - ENVELOPPE

1 - **DALLE COMBLES:** Sur le plancher en bois des combles, une isolation en ouate de cellulose est insufflée entre les tirants de la charpente existante.

2 - **MURS REZ NON-CHAUSSÉE:** Les murs intérieurs contre les espaces non chauffés sont isolés avec des panneaux en silicate de calcium de 80 mm ouverts à la diffusion de vapeur.

3 - **PLAFOND CAVE:** Le plafond des caves est isolé par dessous avec la laine de bois qui permet d'intégrer les installations techniques au plafond.

4/5 - **CRÉPIS EXTÉRIEURS RUE ET COUR:** Le crépi existant côté rue est remplacé par un crépi isolant minéral. Il permet de conserver une lecture des embrasures existantes et d'égaliser les différentes épaisseurs. Les embrasures et éléments décoratifs sont protégés avec une peinture minérale. La façade cour sans ornementations est isolée par l'extérieur avec des panneaux minéraux en silicate de calcium et les embrasures sont reconstruites.

6 - **FENÊTRES ET EMBRASURES:** Les fenêtres en PVC double vitrage sont remplacées par des fenêtres en bois avec triples vitrages. Des grilles hygroréglables sont intégrées dans les cadres. Pour réduire les ponts thermiques et améliorer l'étanchéité à l'air, des nattes de chanvre sont posées dans les embrasures.

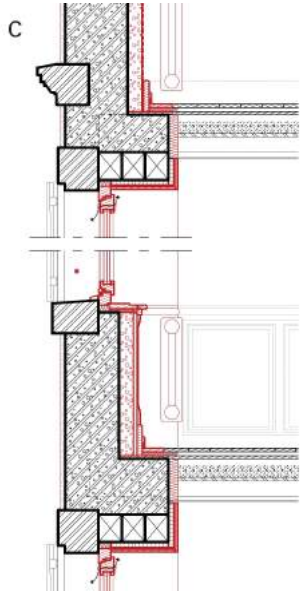
7 - **SOL REZ:** Afin de préserver la hauteur et les cadres des portes existantes, la dalle du rez-de-chaussée sur vide sanitaire est isolée uniquement avec une fine couche de liège ou un isolant plus performant.

8 - **ISOLATION INTÉRIEURE:** Sur la façade rue, une isolation intérieure en panneaux de silicate de calcium de 60 mm ouverts à la diffusion de vapeur complète l'intervention sur les murs intérieurs, mais nécessite des travaux conséquents dans les appartements. Une fine couche d'isolation de laine de chanvre permet d'atténuer le pont thermique au niveau des têtes de poutres en bois.

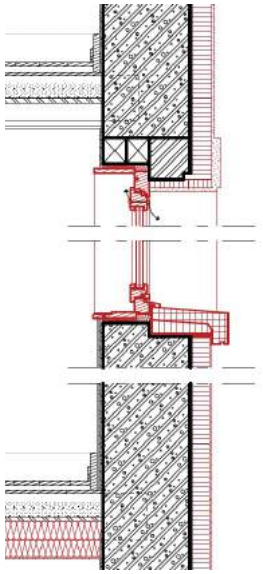
9 - **VALORISATION DES COMBLES:** Un aménagement des combles est envisageable et permet d'exploiter le volume intéressant sous la charpente isolée.

# BUILDING ENVELOPE

## STREET FACADE– COURTYARD FACADE




Insulating render on the street façade improves the performance of the walls and preserves the natural stone embrasures.



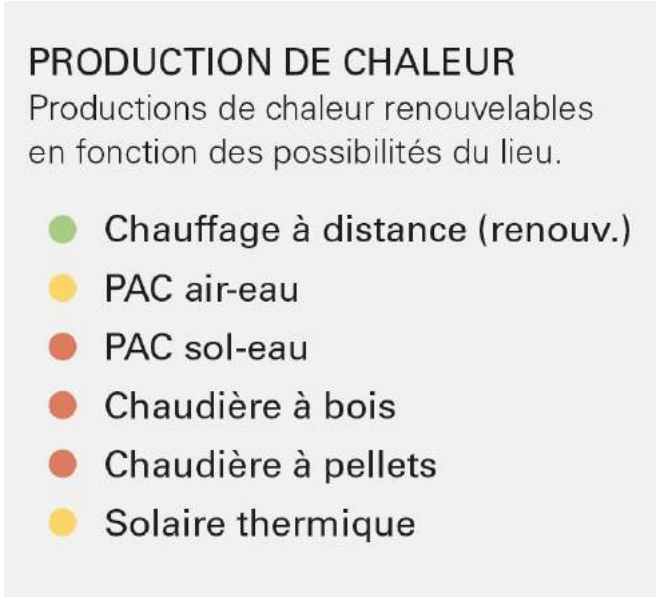
The courtyard façade is insulated with high-performance perimeter insulation.

# TECHNICAL INSTALLATIONS

## HEATING
Fossil heating replaced by a type of renewable heat production depending on the location.

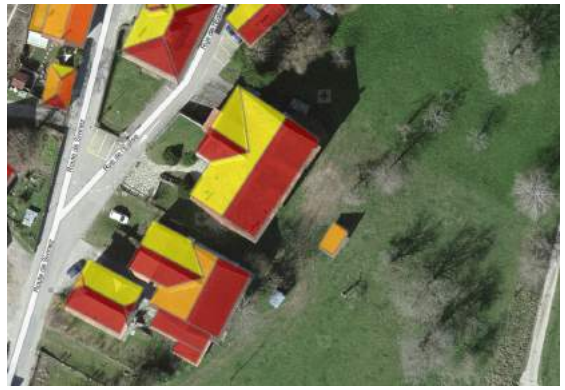
## VENTILATION
Implementation of a ventilation concept.

## ELECTRICITY
Reducing electricity consumption and use of solar energy.

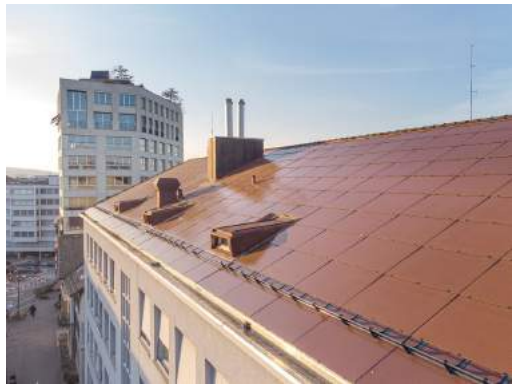


# SOLAR ENERGY





Possible location


Type of product

# DETAILS AND MATERIALS

## LOW CARBON MATERIALS

1 - Attic slab insulation

2 - Insulation of walls against unheated areas

3 - Cellar ceiling insulation

4 - Exterior wall insulation on courtyard side

5 - Insulating plaster on the street side

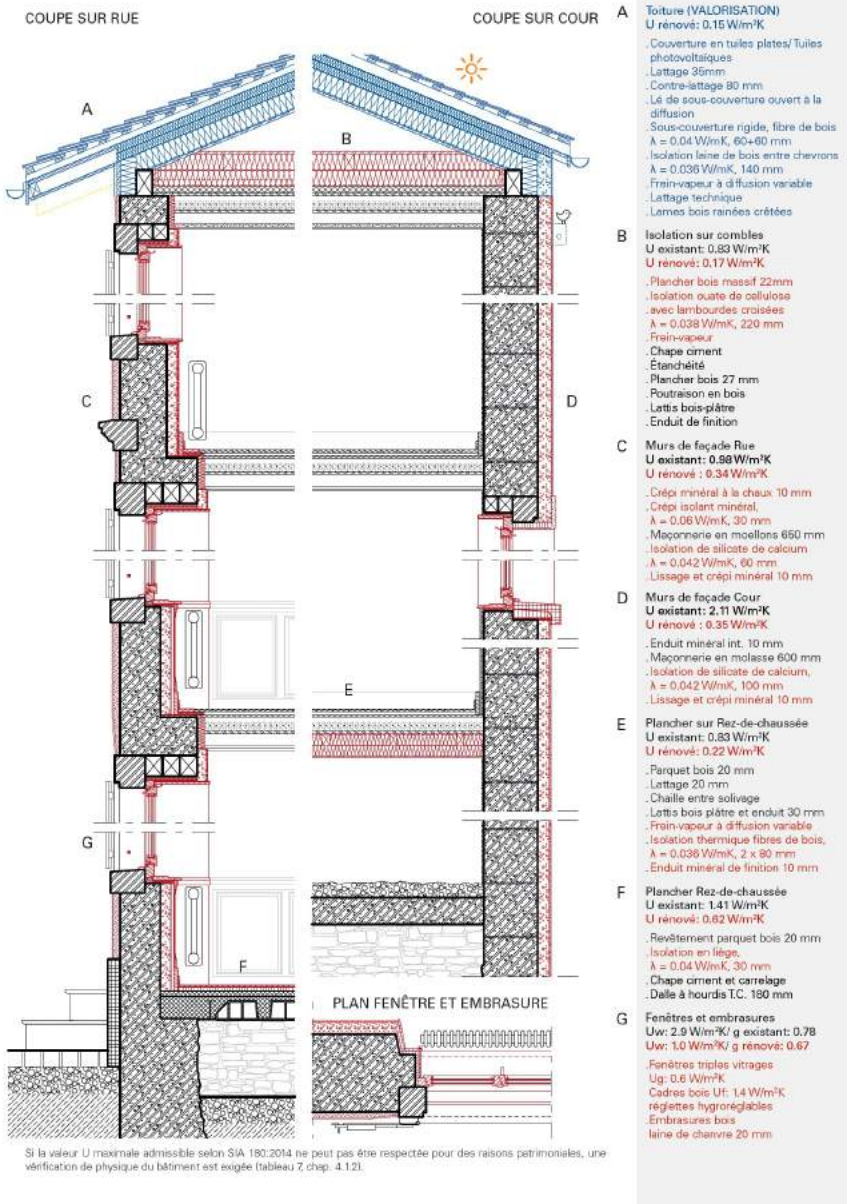
5' - Renewable district heating

6 - Changing windows

7 - Ground floor insulation

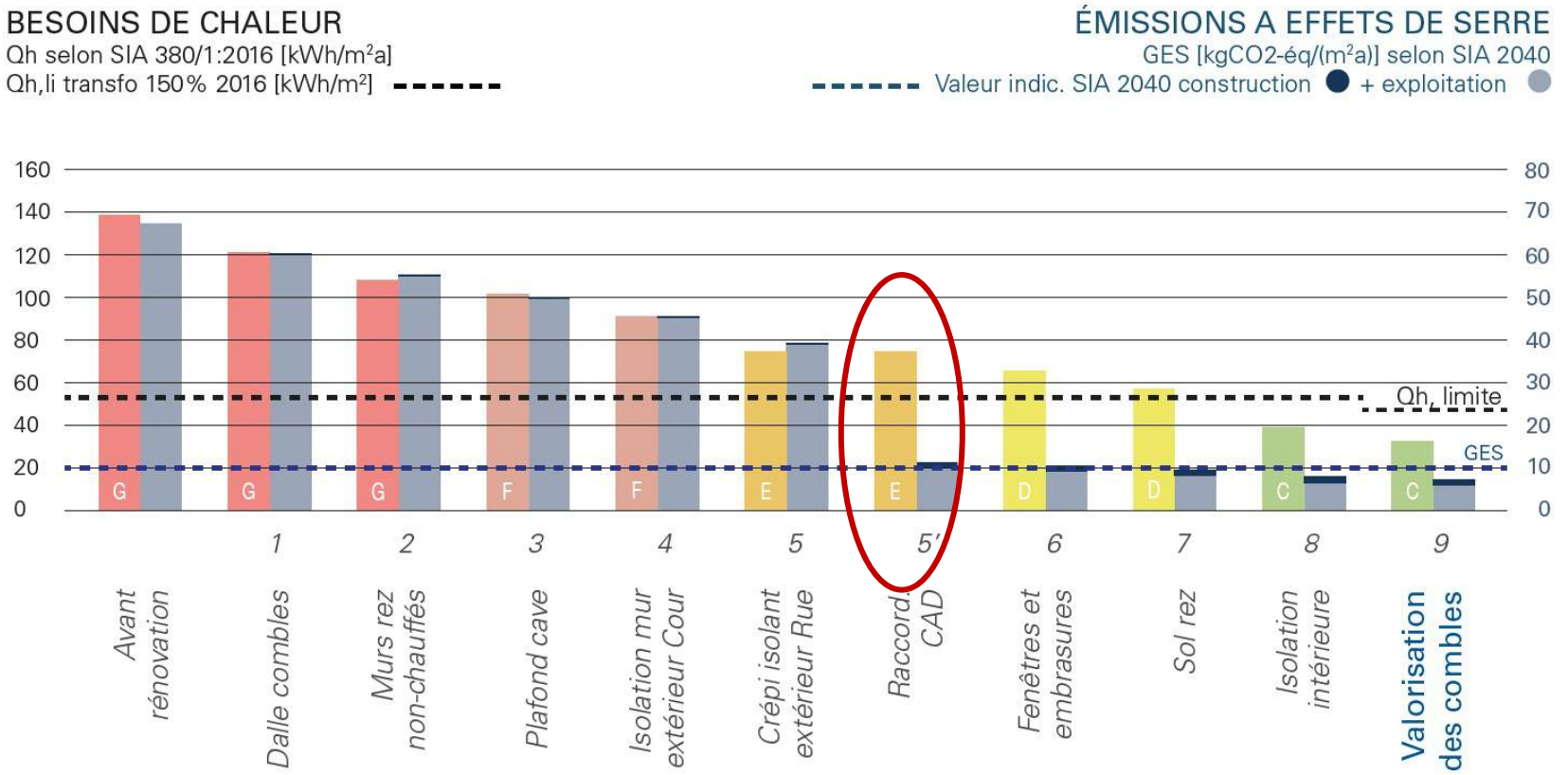
8 - Interior insulation

9 – Densification of attic space



# STEPWISE INTERVENTIONS

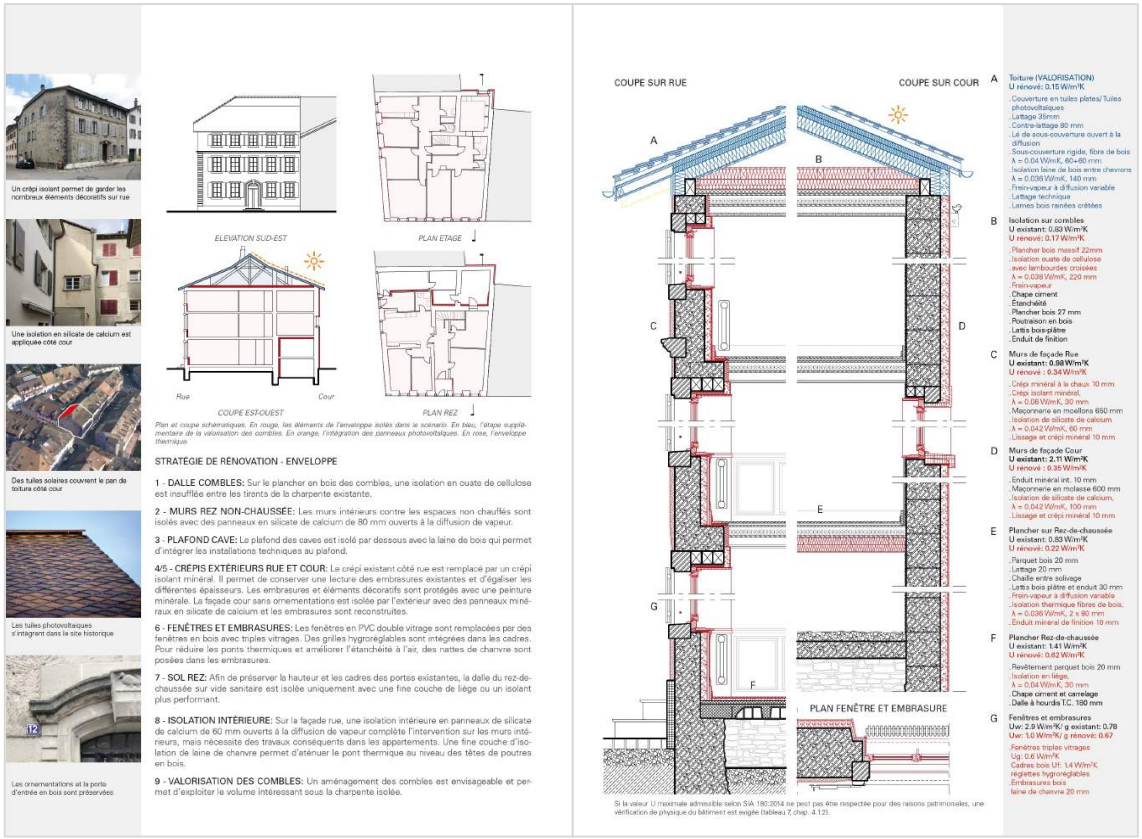
Heat requirement and green house gas emissions




- In all case studies, it is possible to achieve the carbon targets with reasonable measures at the envelope level (label D), while changing the heat production to a renewable energy source.
- When is the best moment to change the heating system?

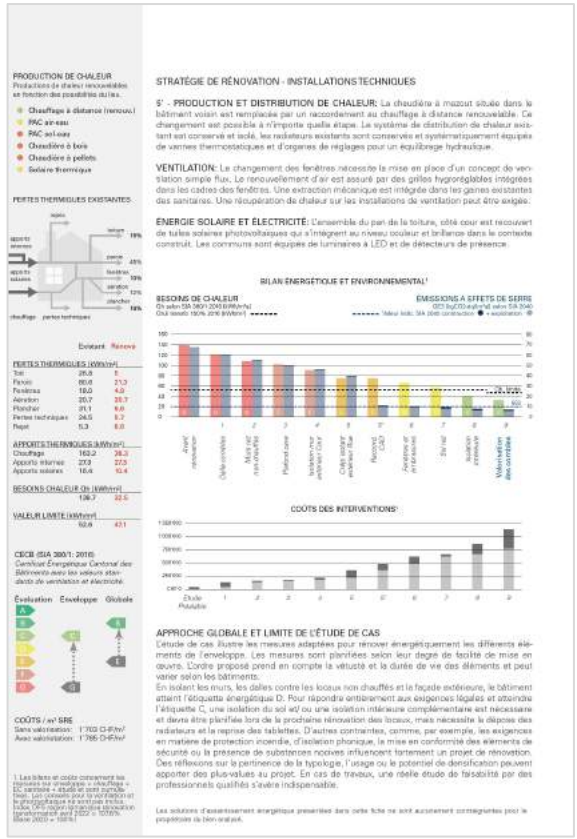
# ROADMAP FOR SUSTAINABLE RENOVATION

Roadmap illustrating necessary works and investments as well as the impacts of stepwise interventions, showing technically and economically viable renovation measures ensuring the overall achievement of the climate targets.

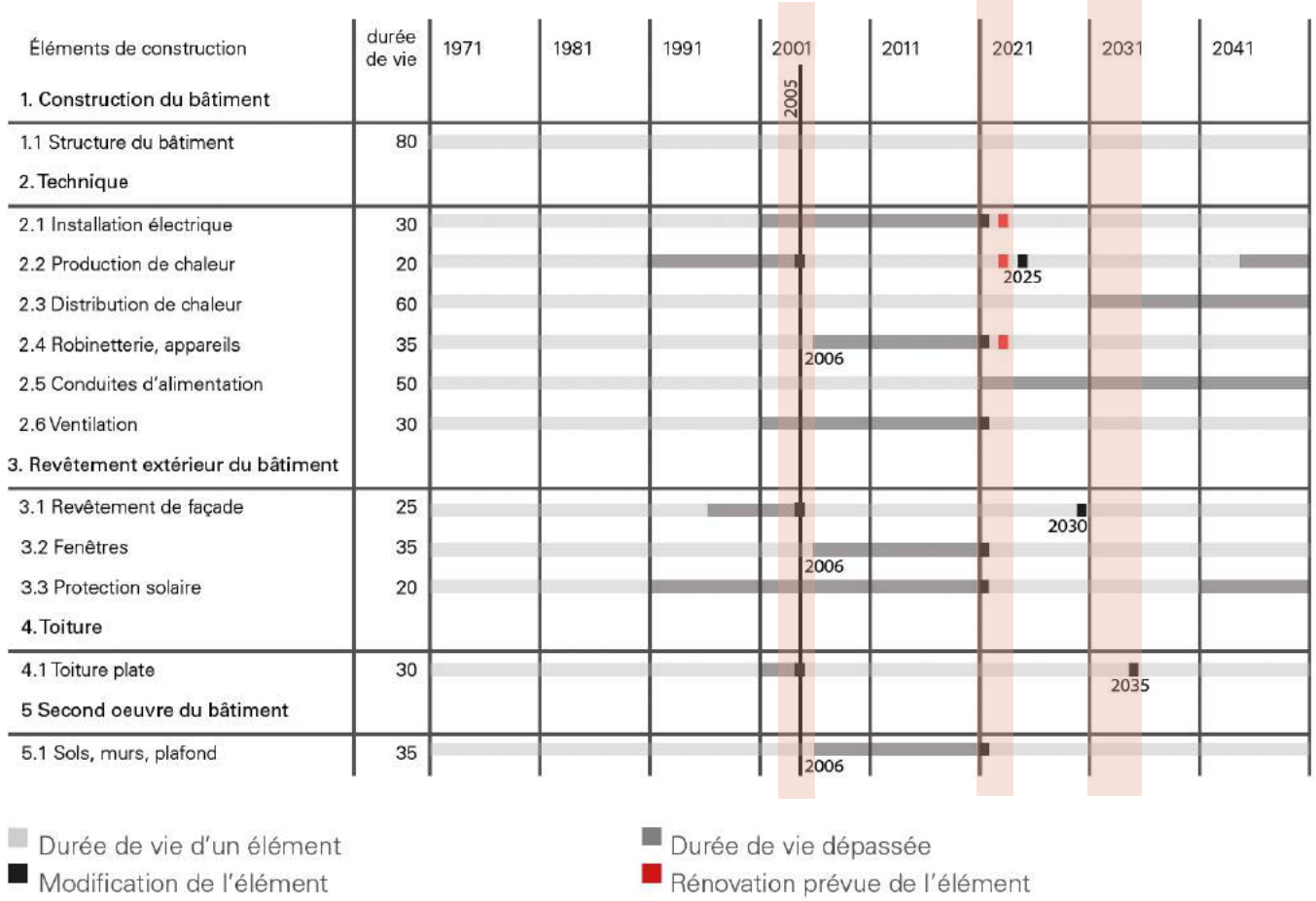






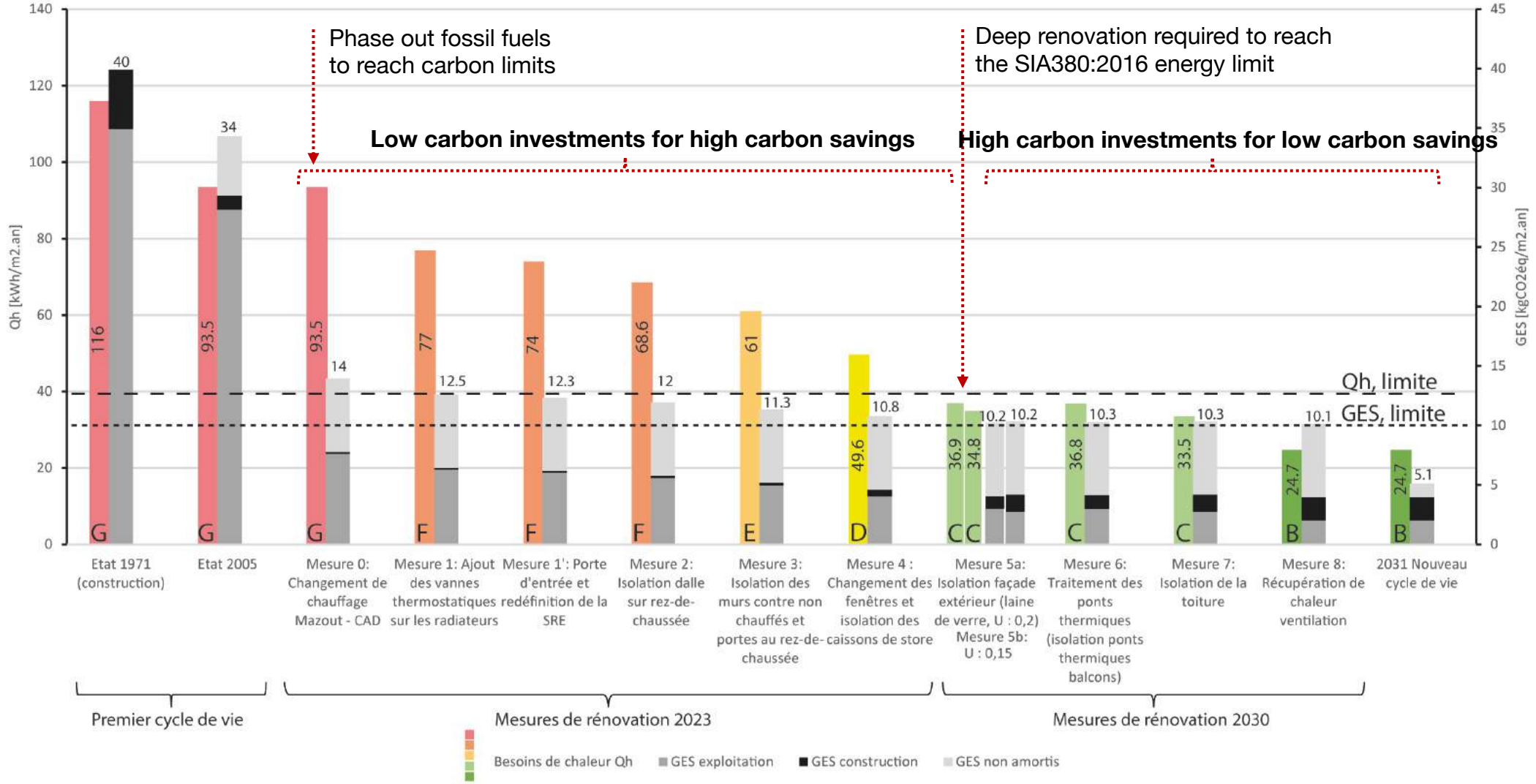
# OBSOLESCENCE AND LIFE CYCLE

RenoBAT-FR_GLOBAL APPROACH

# ENERGY BALANCE AND ECO-BALANCE

## STEPWISE MEASURES



# ROADMAP

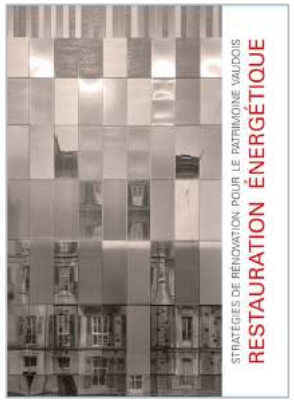
## GLOBAL APPROACH

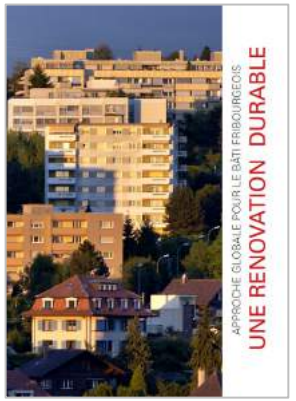
- Renovations are only valid if they consider the lifetime of the elements, they preserve the existing qualities and create new ones. Renovations must, therefore, be considered as **an optimization process in a sustainability perspective that includes embodied and operational emissions and time frame of interventions.**
- While renovation strategies are not always relevant from a carbon perspective, **other needs must be considered** for their implementation like comfort, aesthetics, building physics, health aspects, potential of densification (thermal bridges, condensation, mould), as well as other obsolescences (safety aspect, fire and noise protection, harmful substances, etc.).
- **The type sheets are a support tool for planners and departments concerned**. However, to guarantee sustainable renovations, it is necessary to actively encourage and finance global studies by qualified professionals as a basis for authorizations and subsidies.
- **An individual roadmap gives the owner a viable idea on the necessary works and investments**. Stepwise interventions enable the renovations to be technically and economically feasible while ensuring the achievement of the overall climate targets.

# BUILDING TYPOLOGY

- Renovation coaching tool
- Decision-making tool for public services and local authorities
- Working tool for renovation professionals
- Tool for training and continuing education
- Tool for neighbourhood approach based on construction period similarity



# BUILDING TYPOLOGY

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