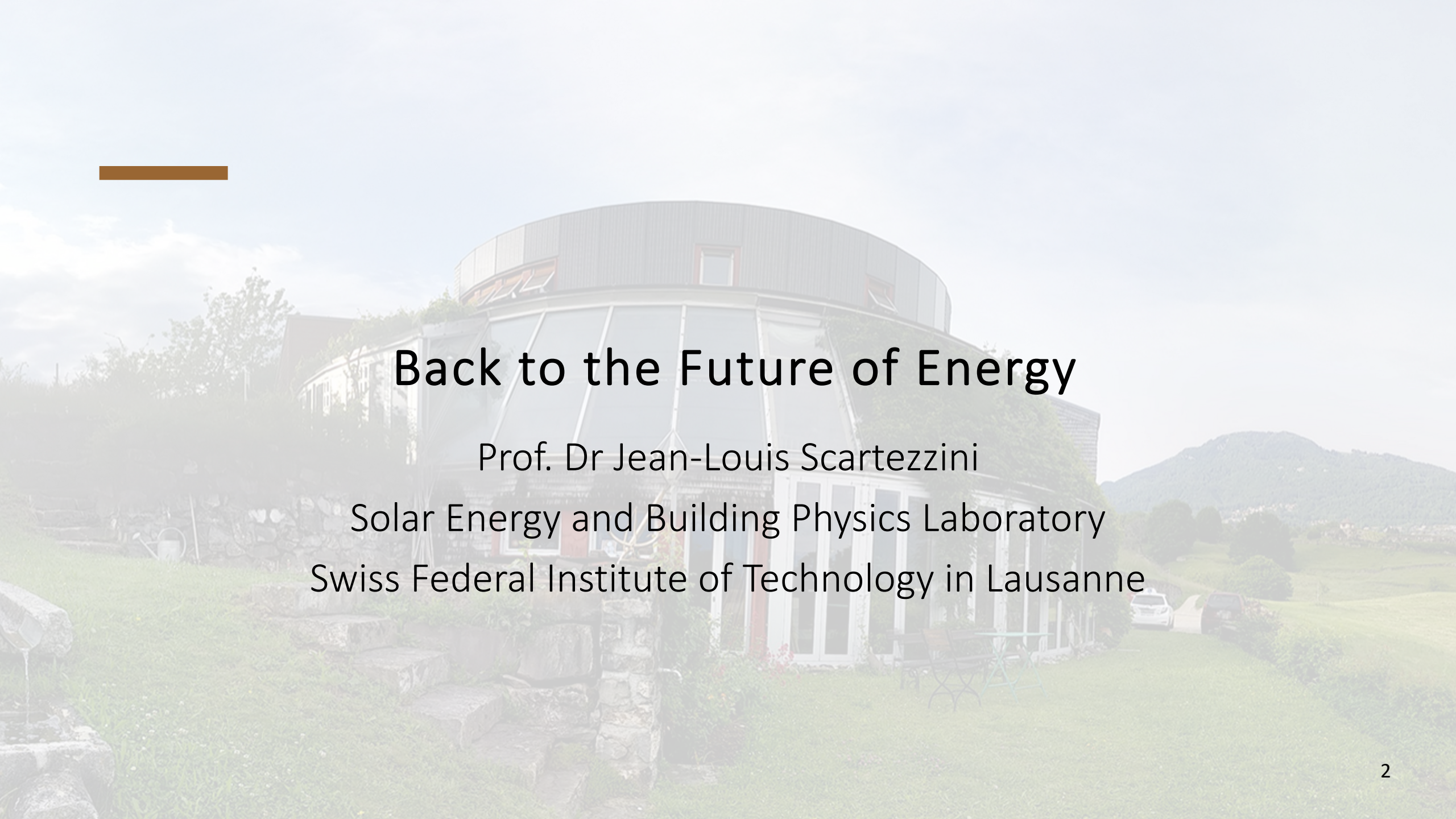
ICES Biennal Workshop VI
29th September 2022
Geneva
Energy Panel 3

Prof. Jean-Louis Scartezzini (EPFL)

Prof. Martin Patel (UNIGE)

Dr Stavros Tolis (ICES)



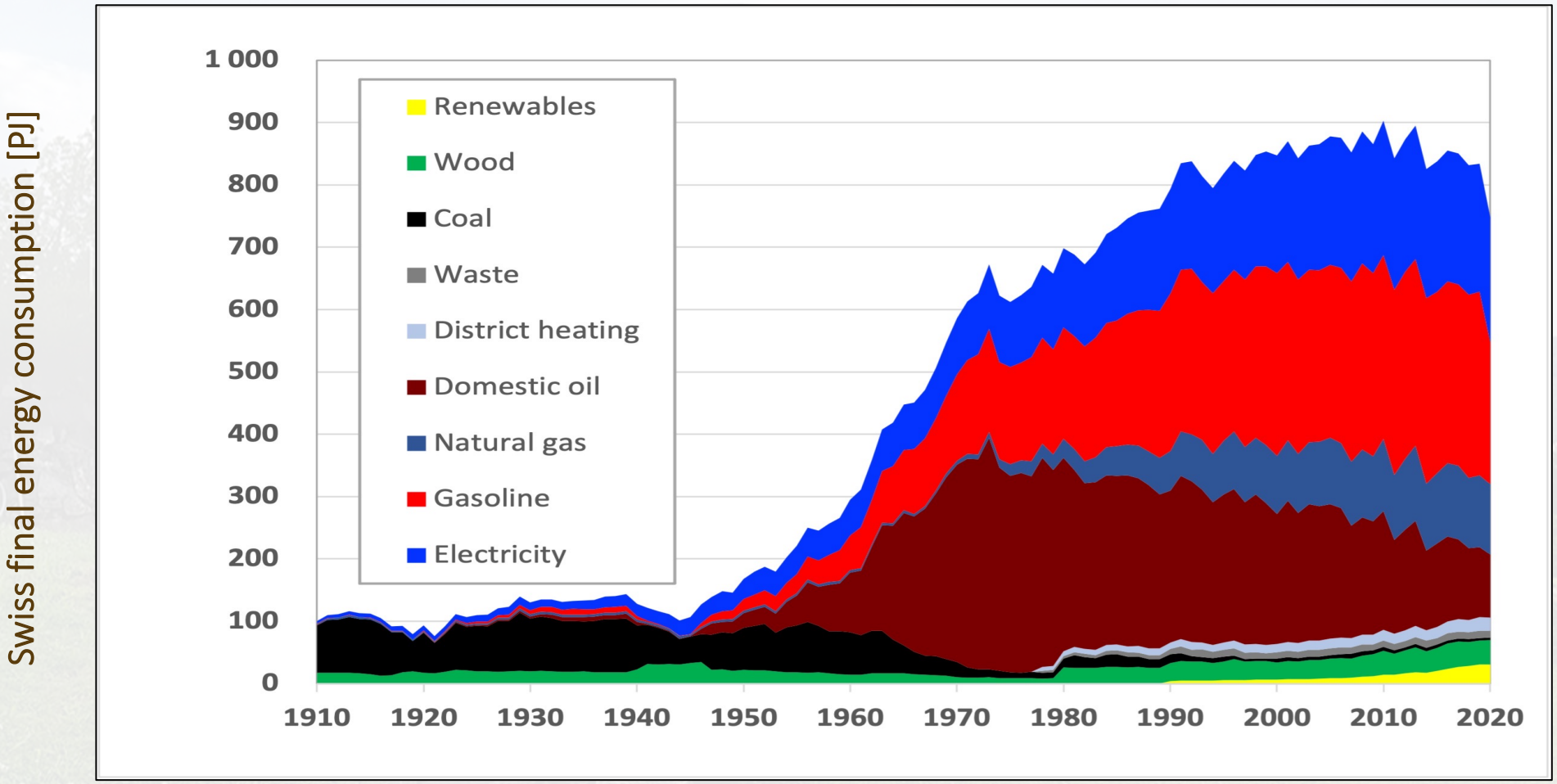
Back to the Future of Energy

Prof. Dr Jean-Louis Scartezzini

Solar Energy and Building Physics Laboratory

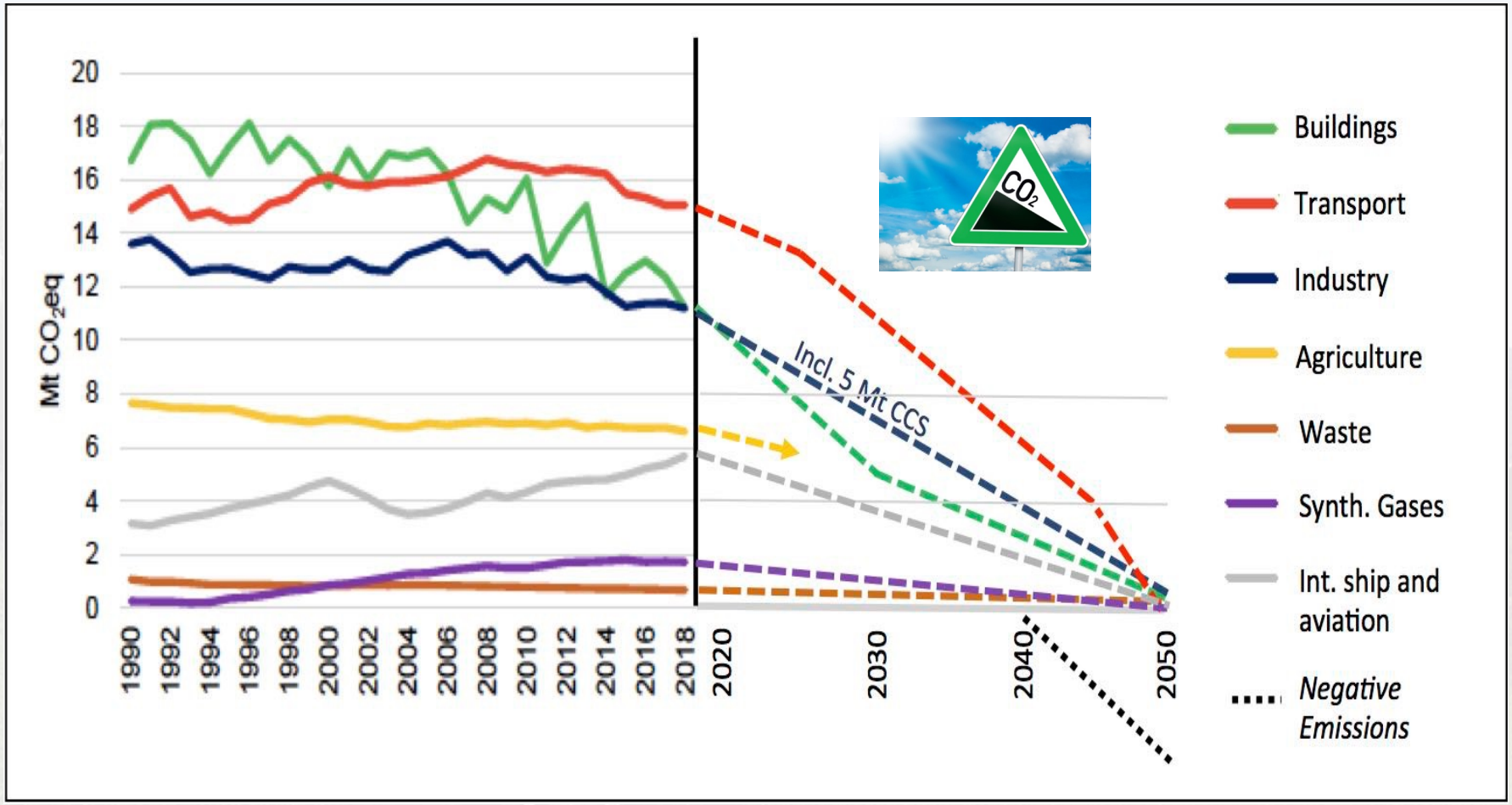
Swiss Federal Institute of Technology in Lausanne

Final Energy Consumption | Switzerland (1910-2020)



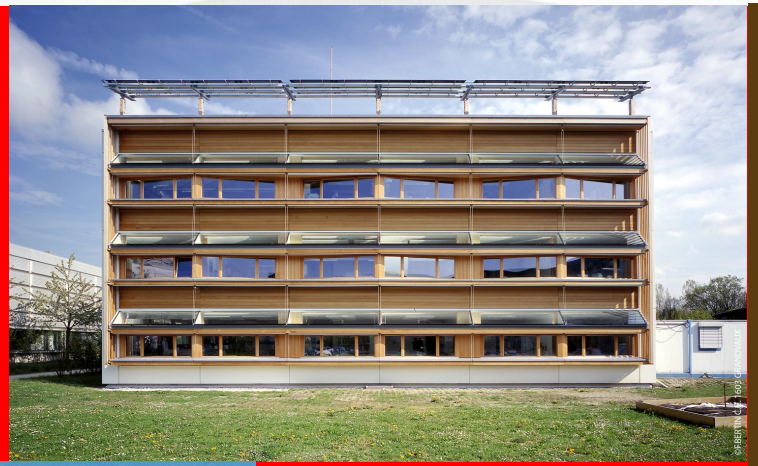
Greenhouse Gases Emissions | Switzerland (1990-2050)

Swiss sectorial GHG emissions [Mt CO_2/y]



Energy Strategy 2050 | EPFL Solar Energy Laboratory

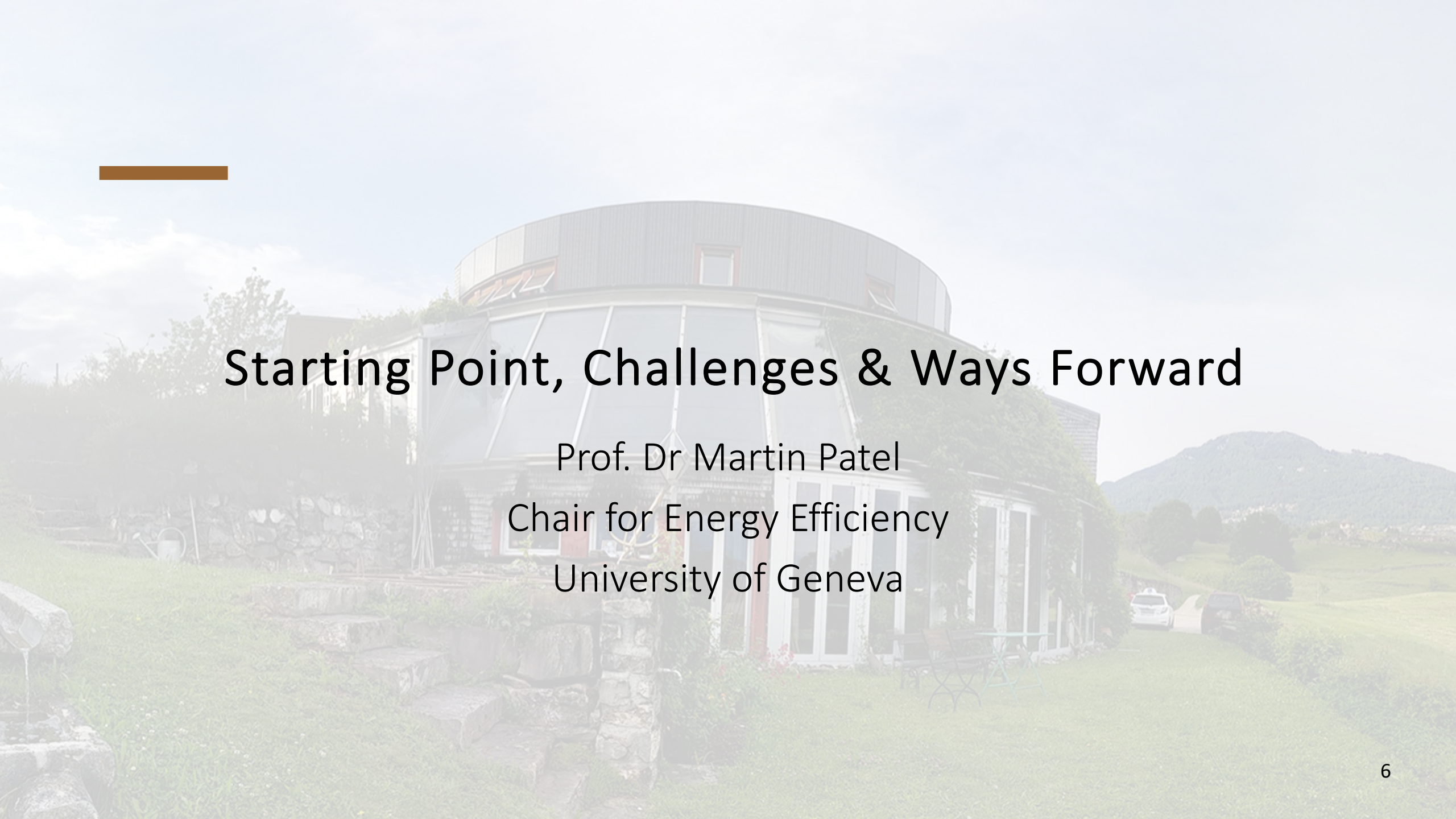
2022



1982

40 Years Climate Actions

- Bioclimatic Architecture
- Passive Solar Systems
- Air Infiltration & Ventilation
- Indoor Environment Quality
- Biomimetic Building Control
- PV Solar Systems
- Daylighting Systems
- Solar Nanotechnologies
- Urban Physics



Starting Point, Challenges & Ways Forward

Prof. Dr Martin Patel

Chair for Energy Efficiency

University of Geneva

Starting Point & Challenges

- **Today:** 40% of national final energy demand, 36% of CO_2 emissions
- **Tomorrow:** Complete decarbonisation of building stock
- **Evolution:** Energy demand decreasing and REN increasing but not on track with energy and climate policy goals
- **Challenges**: Existing buildings, with numerous hurdles
  - Energy retrofit rate of only 1% p.a.
  - Long payback time for retrofitting building envelope
  - Avoidance of biomass use
  - Noise from ASHP; challenges related to large ASPH and geothermal
  - District heating and cooling requiring coordinated effort
  - Lord-tenant dilemma, multiple ownership

The Problem & The Way Forward

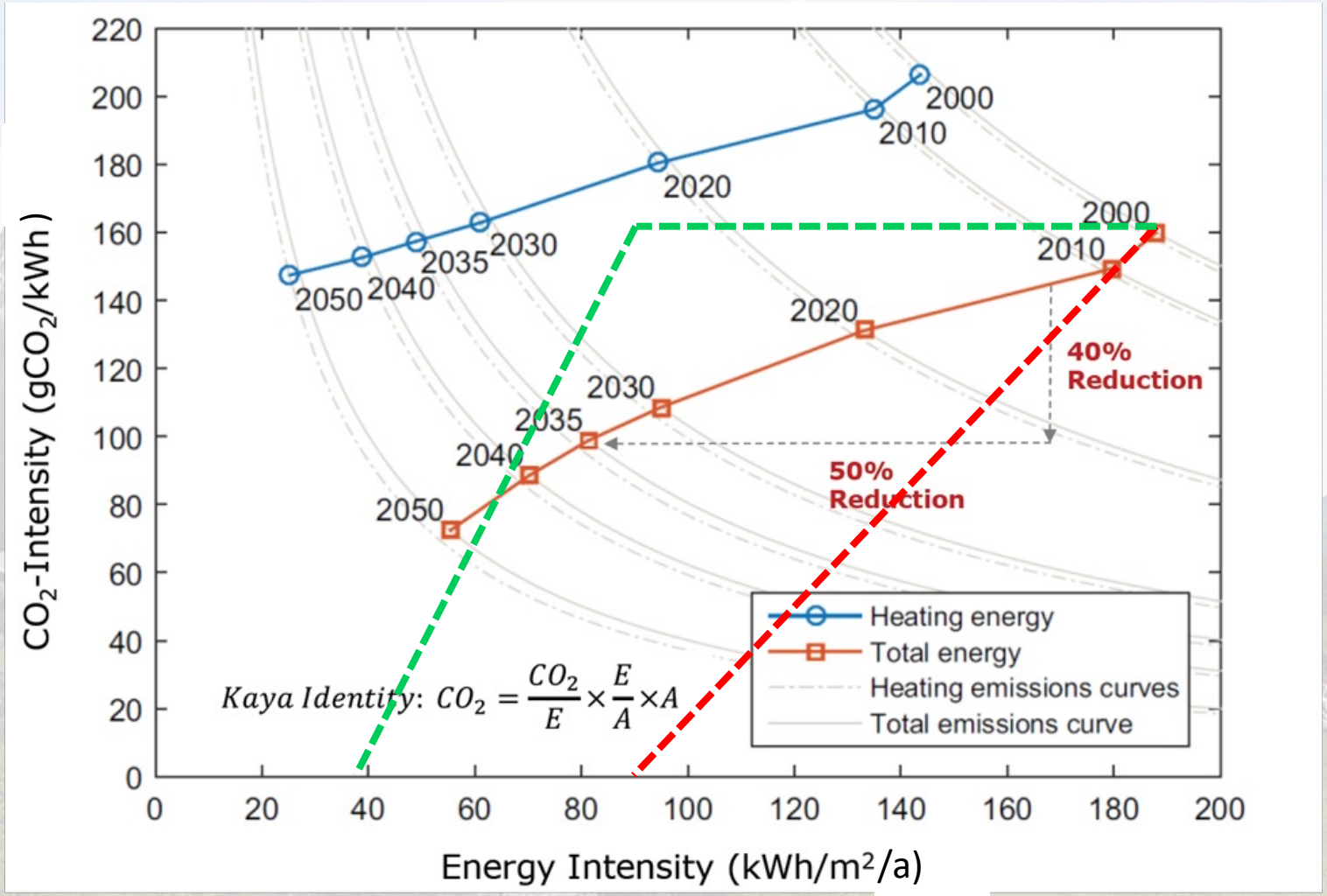
Final energy for space heating in kWh/m²/a

FINAL ENERGY		AGE	URBAN	SUBURBAN	RURAL	AVERAGE	
	MFH	≤1920	112	121	145	124	94
		1921-'45	125	144	169	136	
		1946-'60	124	134	151	130	
		1961-'70	104	120	130	115	
		1971-'80	100	111	119	108	
		1981-'90	83	89	92	88	
		1991-'00	72	76	76	75	
		2001-'10	47	48	46	48	
		2011-'18	25	23	22	24	
	SFH	≤1920	163	180	199	189	134
		1921-'45	174	182	189	182	
		1946-'60	171	187	197	187	
		1961-'70	178	188	194	189	
		1971-'80	147	150	164	155	
		1981-'90	104	104	112	107	
		1991-'00	79	82	86	83	
		2001-'10	56	50	50	51	
		2011-'18	26	25	25	25	
	AVERAGE		103	108	126	112	

Streicher et al. 2019

- Savings by factor 3 to 8 and more
- Thermal performance of envelope
- Heat pump (COP)
- Heat recovery; reversible heat pumps
- Solar
- Synergy
- (Lighting, appliances, hot water)
- Optimisation of operation: -15%

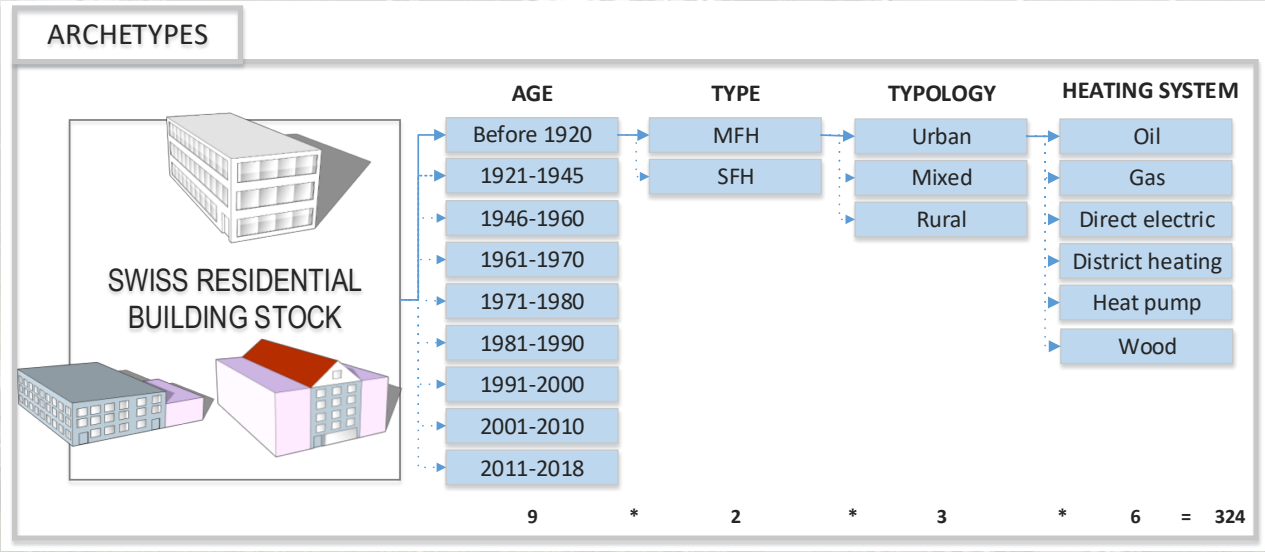
Kaya Identity for Buildings

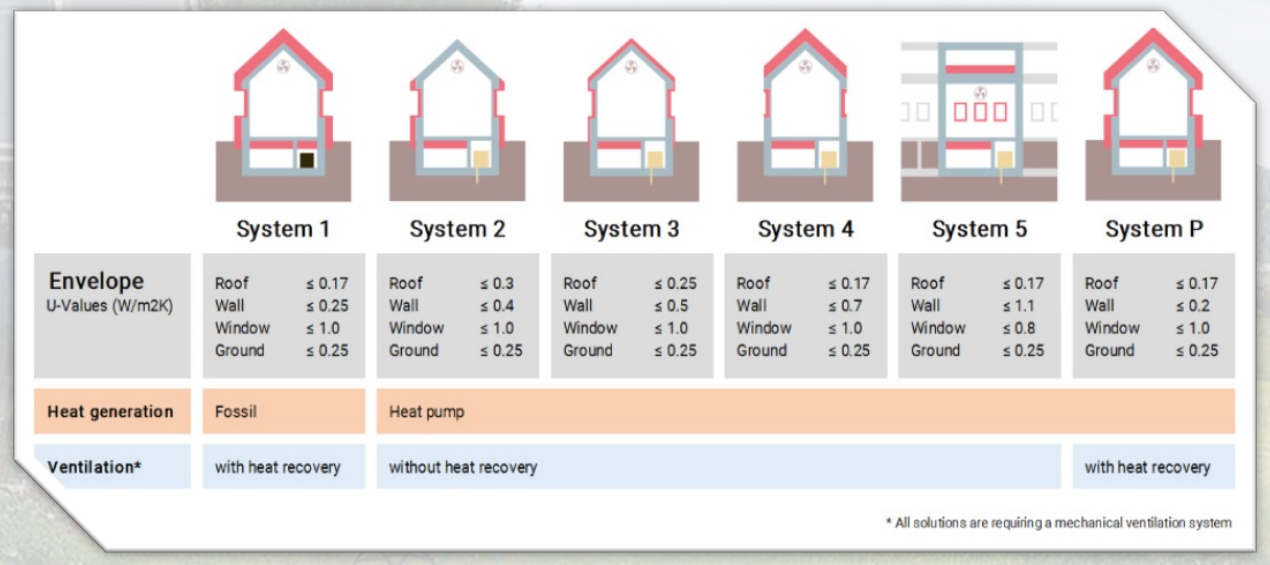


Source: Mavromatidis et al., «A strategy for reducing CO2 emissions of buildings […]», Energy Policy, 2016.

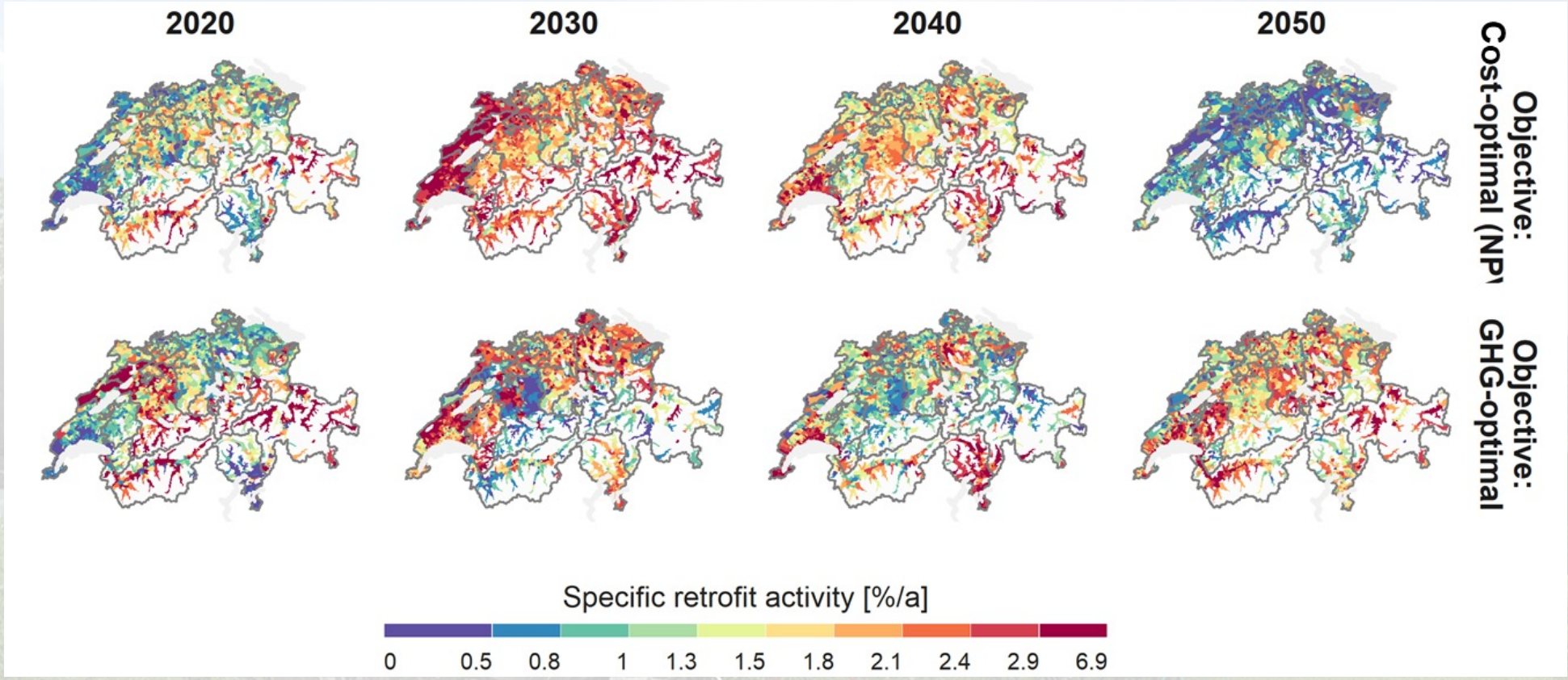
Key Solutions

- **Numerous technologies** allowing to reduce final energy use (active, passive; unconventional)
- **Tools** for planning **what to do where and when**
- Digital tools also for **monitoring** (e.g., fault detection) and **control** (smart, DR)





Pathways toward Net Zero CO_2 Emissions



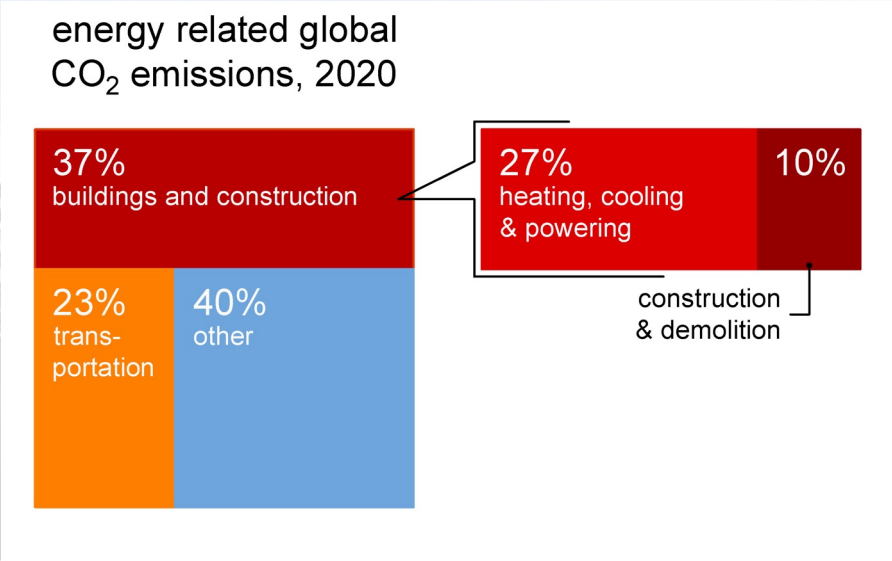
Further challenges include:

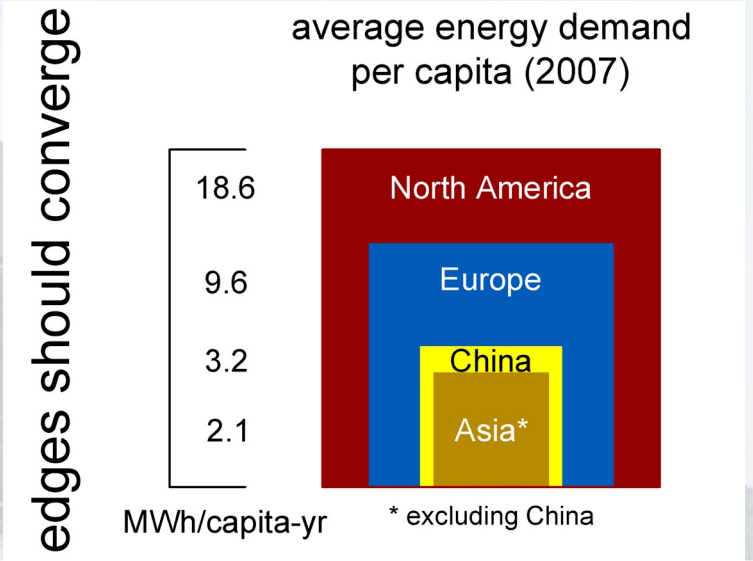
- Imbalances, esp. for prosumers: daily (DR), weekly (e.g., thermal energy storage) and seasonal
- Low energy retrofit rate, long payback periods etc. → Policy, actors, workforce, …

Setting the Proper Policies and Strategies toward Improved Building Energy Efficiency

Dr Stavros V. Tolis
ICES Foundation
Geneva

Current Worldwide Status





13,000 buildings has to be added every day until 2050, just to keep up with global population growth

By 2050 it is projected that an additional 3.0 billion people will join the 3.5 billion people already living in cities

3 billion people have no access to modern energy sources

1.4 billion people have no access to electricity

Technology has made a wholesale transformation possible today while maintaining lifestyles in high income countries and continuing to lift billions out of poverty

Policy Basic Goals

- Incentivizing stakeholders to make existing properties more energy-efficient
- Ensuring that all new buildings will be far more energy-efficient (and cleaner) than it has been in the past
- Providing the criteria when to retrofit and when to demolish and rebuild buildings
- Facilitating research and development
- Educating stakeholders and communities about green-building technology and energy-efficiency of buildings

Policy Wishful List

- Be intuitive, rational and realistic
- Be long-term reliable, consistent and coherent
- Be flexible on and open on how to achieve the goals set
- Receive regular feedback and adapt easily to variable conditions
- Be subjected to frequent evaluation
- Involve the maximum number of stakeholders possible
- Benefit local economies
- Consider the coupling and interact with other sectors
  (e.g. transportation, energy production, environmental protection, etc.)

Policy Tools & Instruments

Category	Policy Tool/Instrument	Effectiveness
Control and regulatory mechanism – normative instruments	Building codes	High
	Appliance standards	High
	Energy efficiency obligations and quotas / procurement regulations	High
Regulatory informative instruments	Mandatory and voluntary labelling and certification programs / energy efficiency certificate schemes	High / Medium
	Mandatory and voluntary audit programs	High but Variable
Fiscal instruments and incentives	Taxation on household fuels	Low
	Tax exemptions/reductions	High
	Public benefit charges	Medium
	Capital subsidies, grants, subsidized loans	High to Medium
Support, information, and voluntary action	Voluntary and negotiated agreements	Medium to High
	Public leadership programs	Medium to High
	Detailed billing and disclosure programs / Awareness raising, education, information campaigns	Medium / Low to Medium

Barriers to Policy Tools/Instruments

- Long life-time of buildings
- Economic barriers — Huge investment needs with long payback time;
  Disadvantages for low-income households
- Information barriers — Limited knowledge on energy costs and technical options available
- Cultural/behavioral barriers — Difficulty to achieve consensus
  (e.g., multiple ownership, split incentives between tenants and landlords)
- Hidden costs — Monument and heritage or landscape conservation restrictions; differences in installed technologies

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Disadvantages for low-income households

- Information barriers
- Cultural/behavioral barriers
- Hidden costs

- **No capital available**
- **No access to state or bank capital**
- **Own the old and high energy consuming residences**

On the other hand, they are those to profit most

Thank you for your Attention !

To your Questions and Comments !

Bioclimatic House (1999)

Guisan Family

La Tour-de-Peilz / VD