



Switch2Save

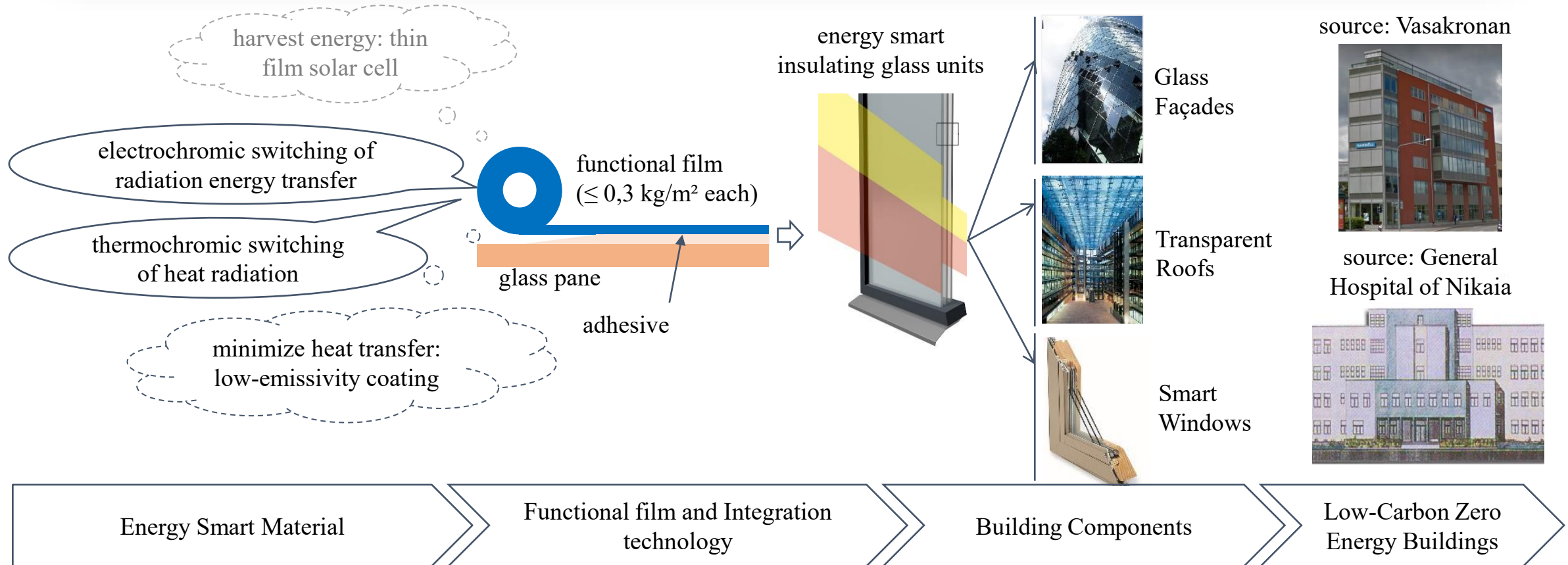
Lightweight switchable smart solutions for energy saving large windows and glass facades



The Switch2Save Idea

Energy efficient buildings through smart and switchable windows!

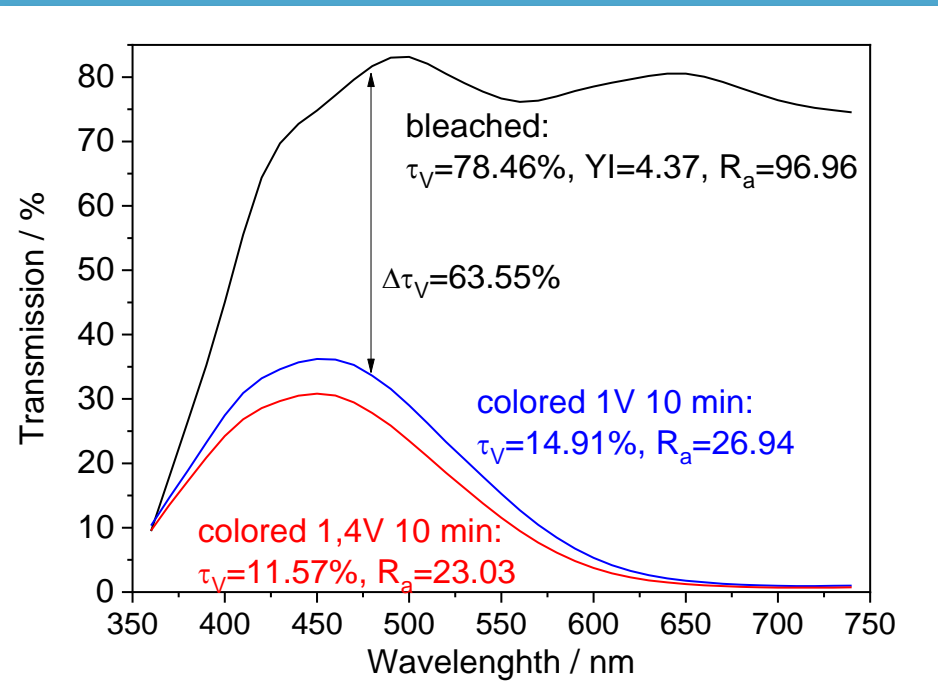
Switch2Save Concept



Electrochromic and thermochromic cells?

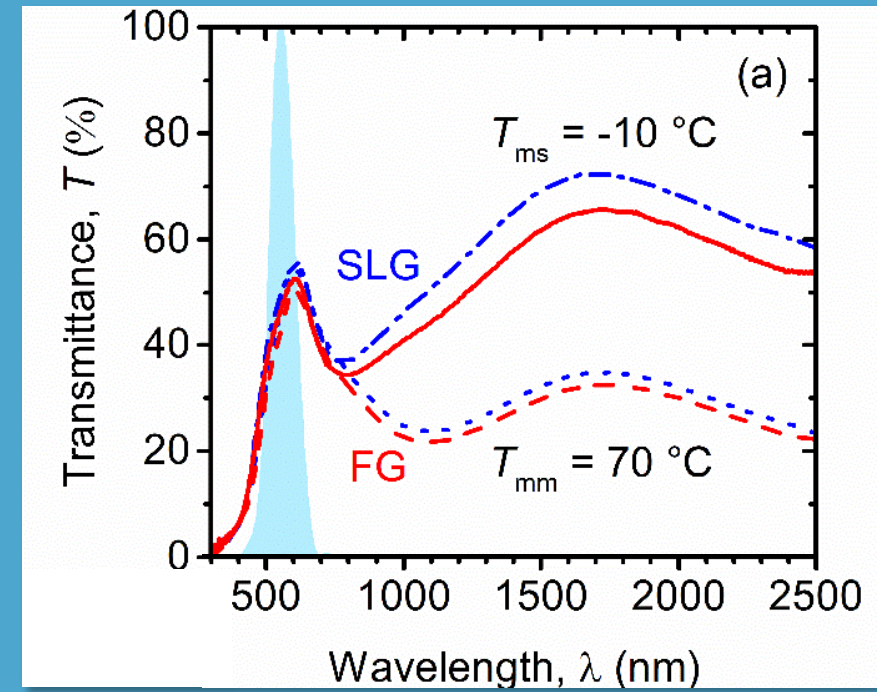
electrochromic cells

active (through voltage) switching of visible light transmittance

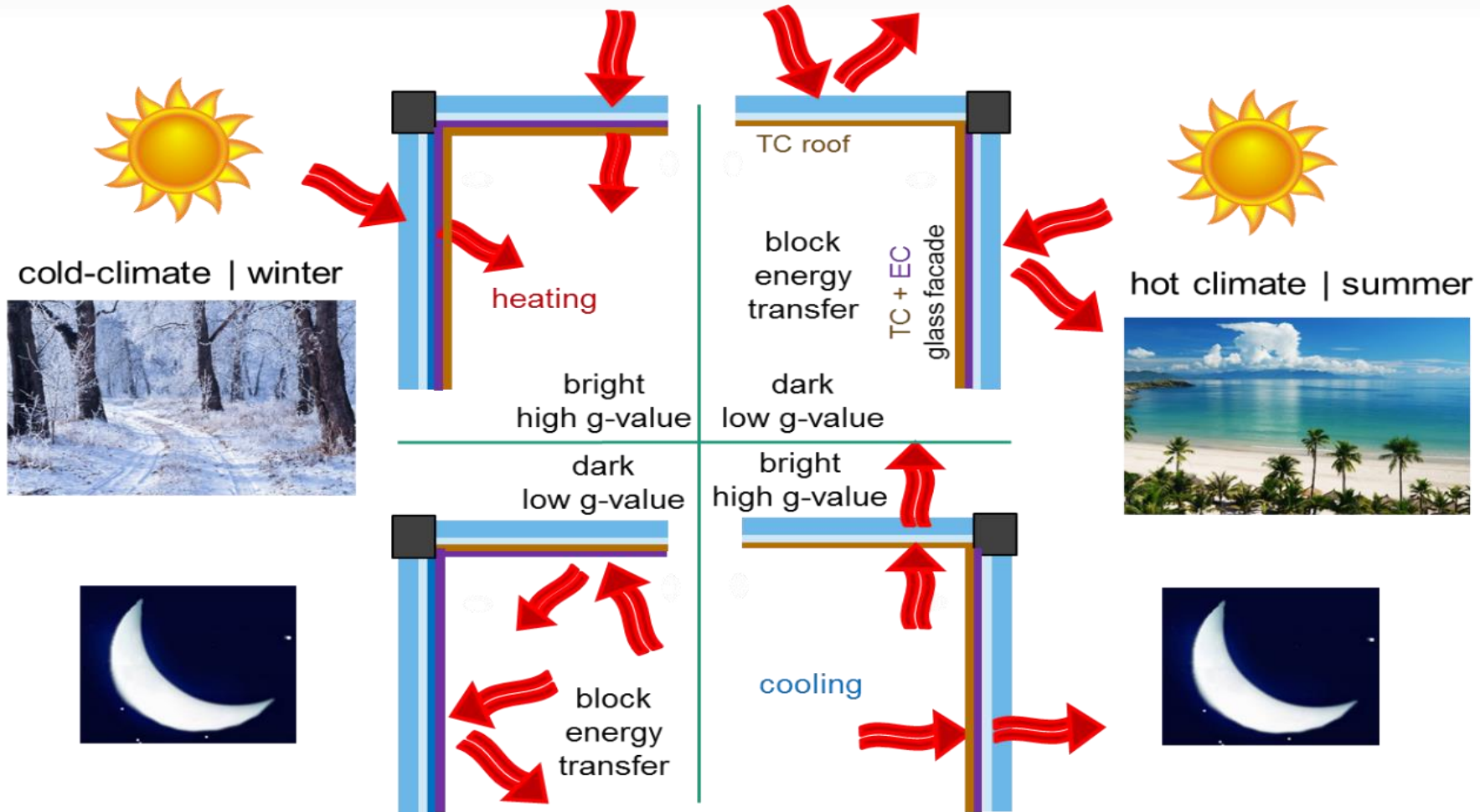


thermochromic cells

temperature dependent switching of infrared transmission



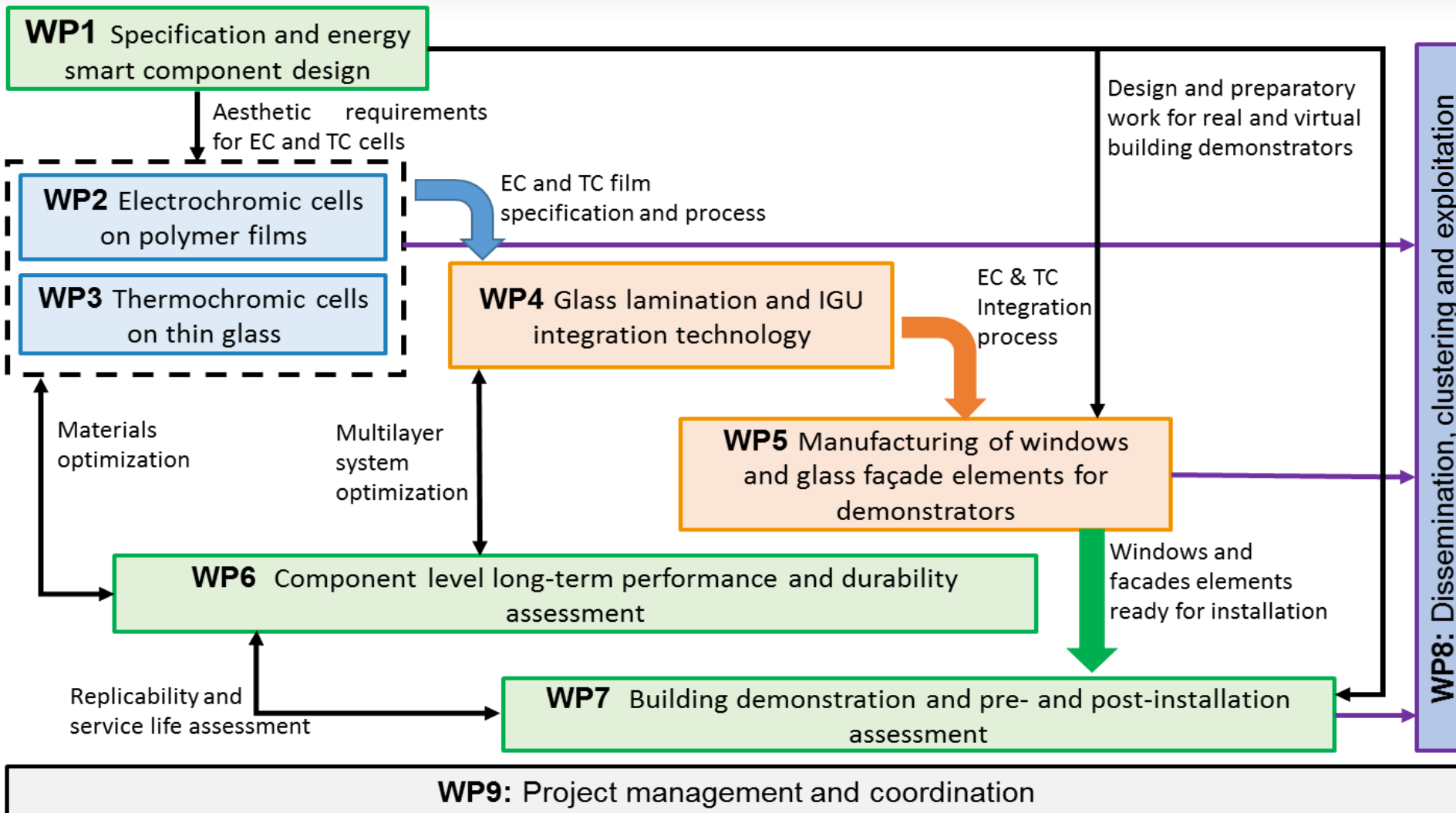
Intelligent Switching Protocols



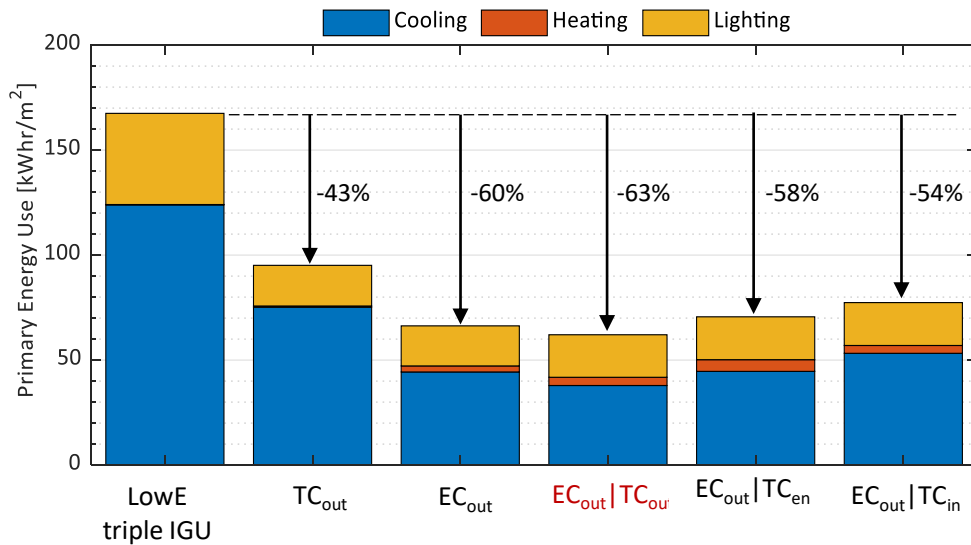
Switch2Save Highlights M1 – M18

Key Results from Work Package 1 to 8

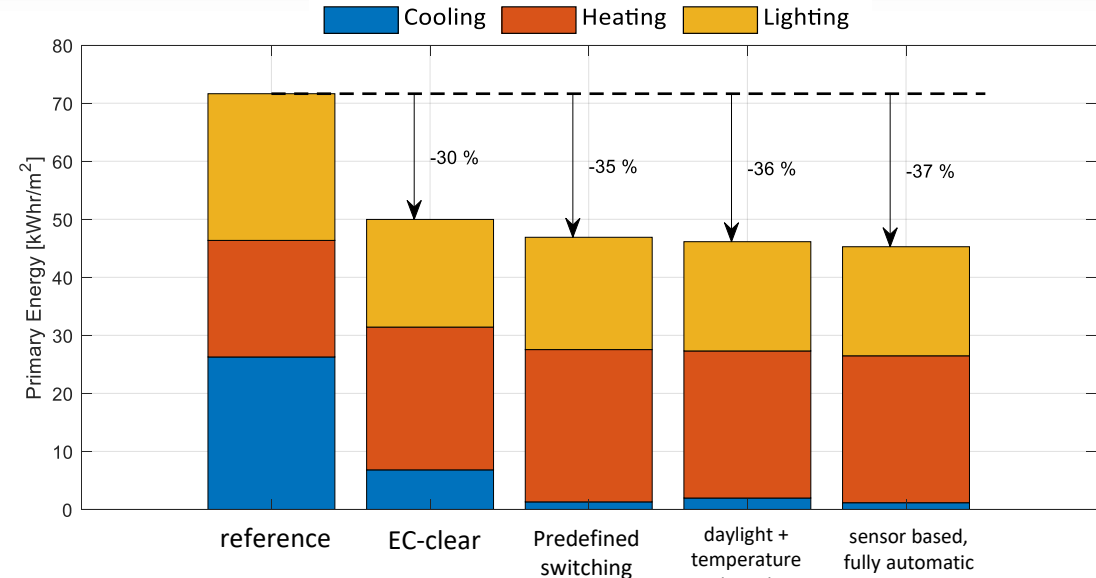
Our work plan



WP1: Evaluate Energy Saving Potential



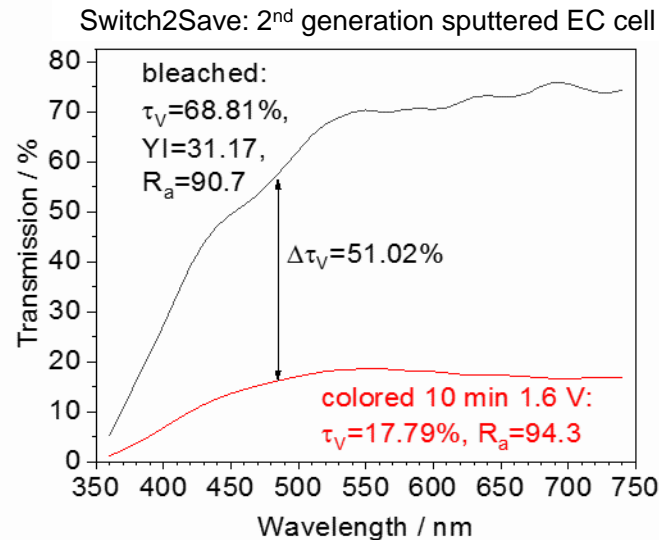
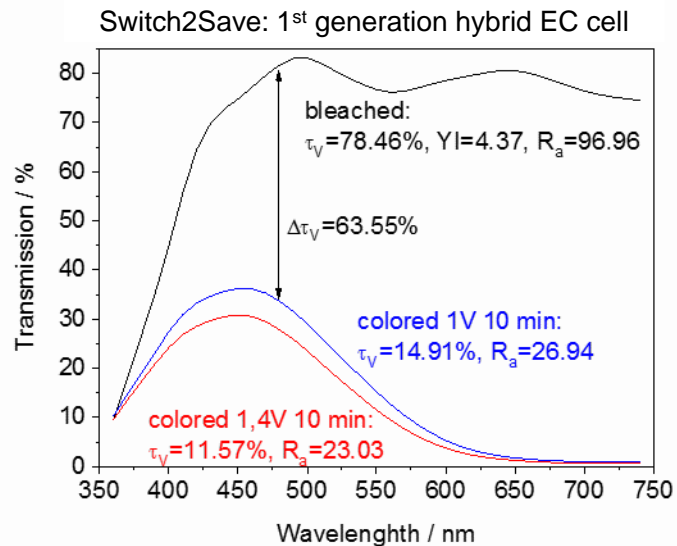
Single floor 12 × 12 m² in an office building in Athens



5 floor office building in Stockholm

- Saving Potential of EC and TC in Athens and Stockholm: Best performer: EC + TC inner side of outer pane
- Maximum saving potential: 30 – 55% due to smart IGU + 5 – 15% due to automatic switching protocol

WP2: Electrochromic Films



- Sputtered cell vs. hybrid cell with Prussian Blue → demonstrators with sputtered cell + further scientific evaluation of hybrid cell
- Roll-to-roll manufacturing process on **1.5 m web width** for 2nd gen sputtered EC cell ready

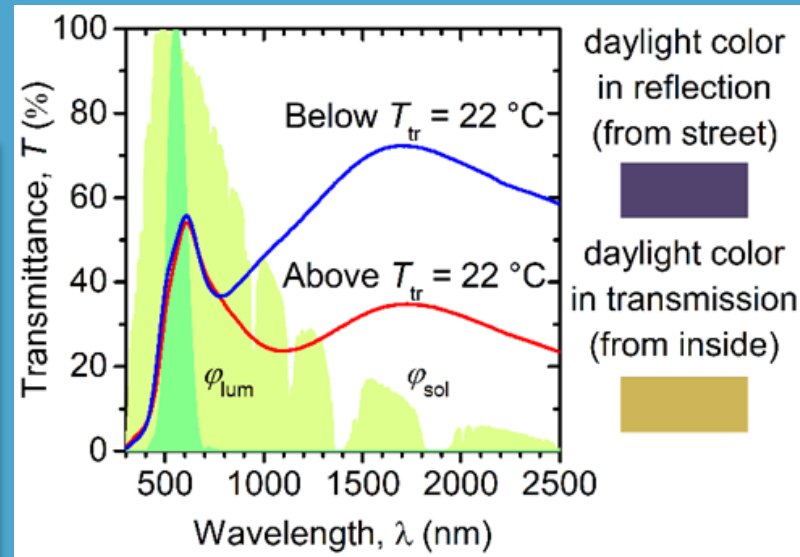


	Reference Sputtered EC cell	Switch2Save: 1 st gen hybrid EC cell	2 nd generation sputtered cell	2 nd generation hybrid cell	Switch2Save Objective
Clear State: VLT CRI YI	61.2% 90 33.7	78.5% 97 4.4	68.8% 91 31	73% 97 14	> 70% >80 < 1 ... 5
Dark State: VLT CRI	18.4% 91	14.9% 27	17.8% 94	30.1% 67	< 10% > 80

WP3: Thermochromic (TC) thin glass

- World's first thermochromic $\text{ZrO}_2/\text{V}_{1-x}\text{W}_x\text{O}_2/\text{ZrO}_2$ stack on ultra thin glass: $T_{\text{tr}} = 22^\circ\text{C}$; $T_{\text{lum}} \approx 50\%$; $\Delta T_{\text{sol}} > 10\%$
- Stoichiometric semicrystalline VO_2 made in Roll-to-Roll on 300 mm width
- Roll-to-Roll equipment upgrade for TC thin glass in finalization

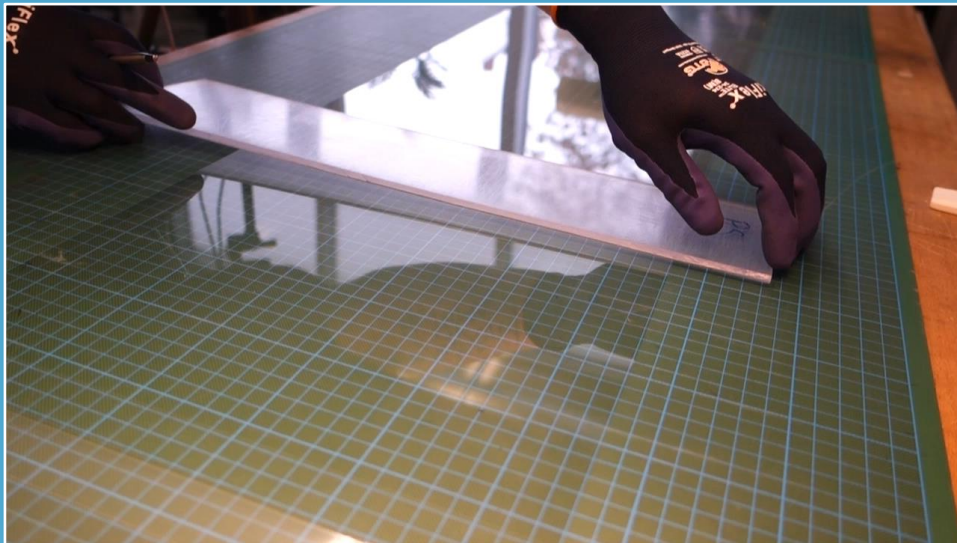
	ZrO₂
AR layer Protection	$h_t = 178 \text{ nm}, n_{550} = 2.09$
	V_{0.984}W_{0.016}O₂
Active layer	$h = 71 \text{ nm}, n_{550} = 2.82, k_{550} = 0.37$
	ZrO₂
AR layer Template	$h_b = 172 \text{ nm}, n_{550} = 2.09$
	Flexible glass
Substrate	$0.1 \text{ mm}, n_{550} = 1.53$



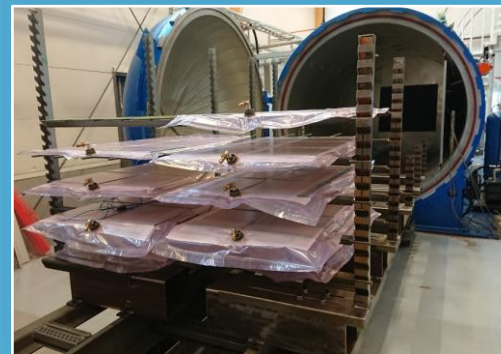
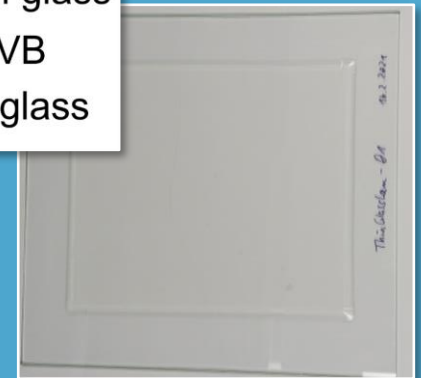
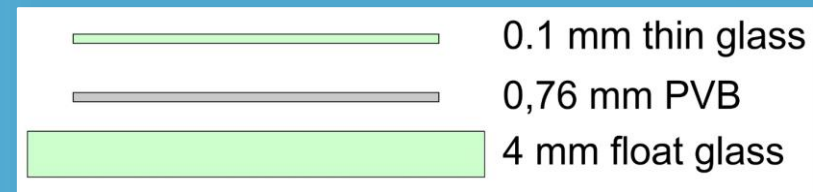
T. Bárta et al., Coatings 10, 1258 (2020)

WP4: IGU Integration Technology

- Ultra thin glass (100 μm): a new material to integrate to established processes
- Detailed instruction videos for glass handling, cutting and treatment



- First successful lamination on 4 mm window pane (18 x 21 cm^2 on 29 x 27 cm^2 floatglass)



- Integration process: Vacuum bag lamination using autoclave setup

WP6: Component Level Durability Tests

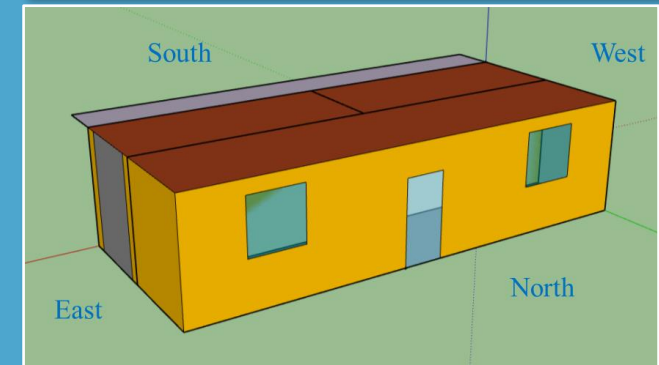
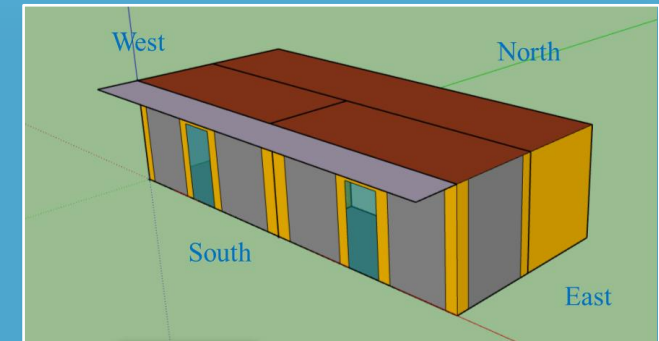
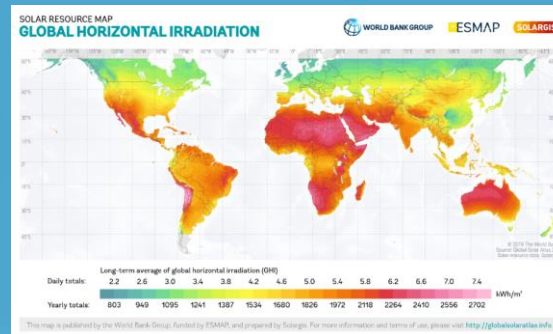
- New nZEB Pilot Building for Window Level Testing @ NTUA
- Smart Glass – Performance and Durability Testing Protocols

ASTM and derived ISO Standards

SWIFT Protocol and IEA Considerations

Switch2Save Test Protocols for Electro- and Thermochromic Windows

- A challenge: Radiation Load Testing
- Local variation in horizontal irradiation
 - Stockholm: 950 kWh / m² / yr
 - Athens: 1700 kWh / m² / yr



WP7: Demonstration in Operation

- Energy consumption monitoring in both demonstration buildings
1 full year before and after energy smart window installation



First **exploitable result**:
Novel multi-sensor for

- CO₂ and VOC concentration
- Temperature
- Humidity
- Air pressure
- Lighting
- Motion / presence



Neonatal and pediatric clinics in Nikaia Hospital, Athens



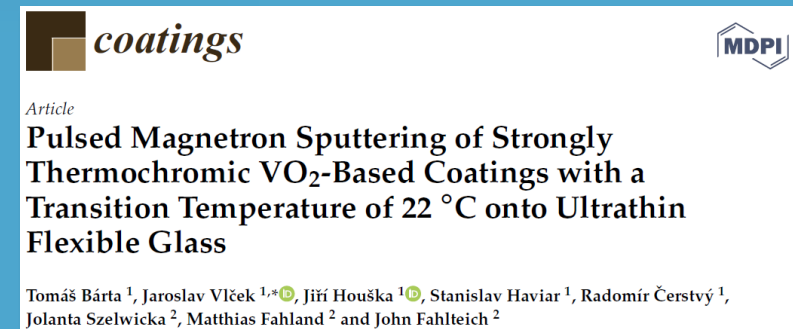
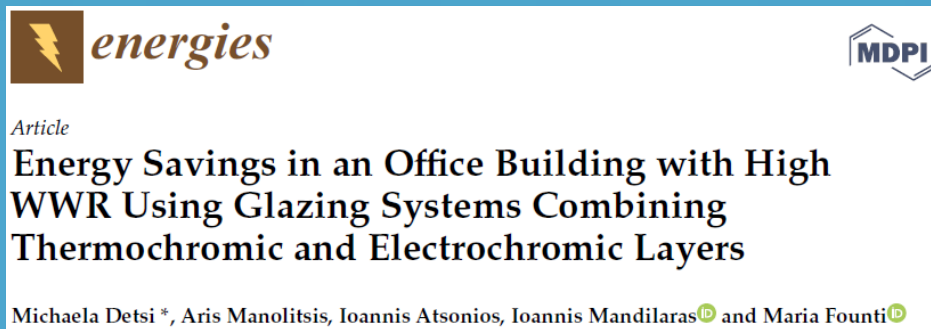
Rental Office Building in Uppsala



Commercial monitoring sensors and platform

WP8: Make Public and Industry aware!

- Two Peer Reviewed Open Access Scientific Publications in 2020



- Workshop: Energy efficient technologies for building envelopes: 25 – 27 Nov 2020
 - 26 presentations, thereof 4 H2020 projects: NRGStorage, Switch2Save, PowerSkin+ and RenoZEB
 - ~ 90 different participants (day 1: ~ 60; day 2: ~ 55; day 3: ~ 43)





Thank you very much for listening!