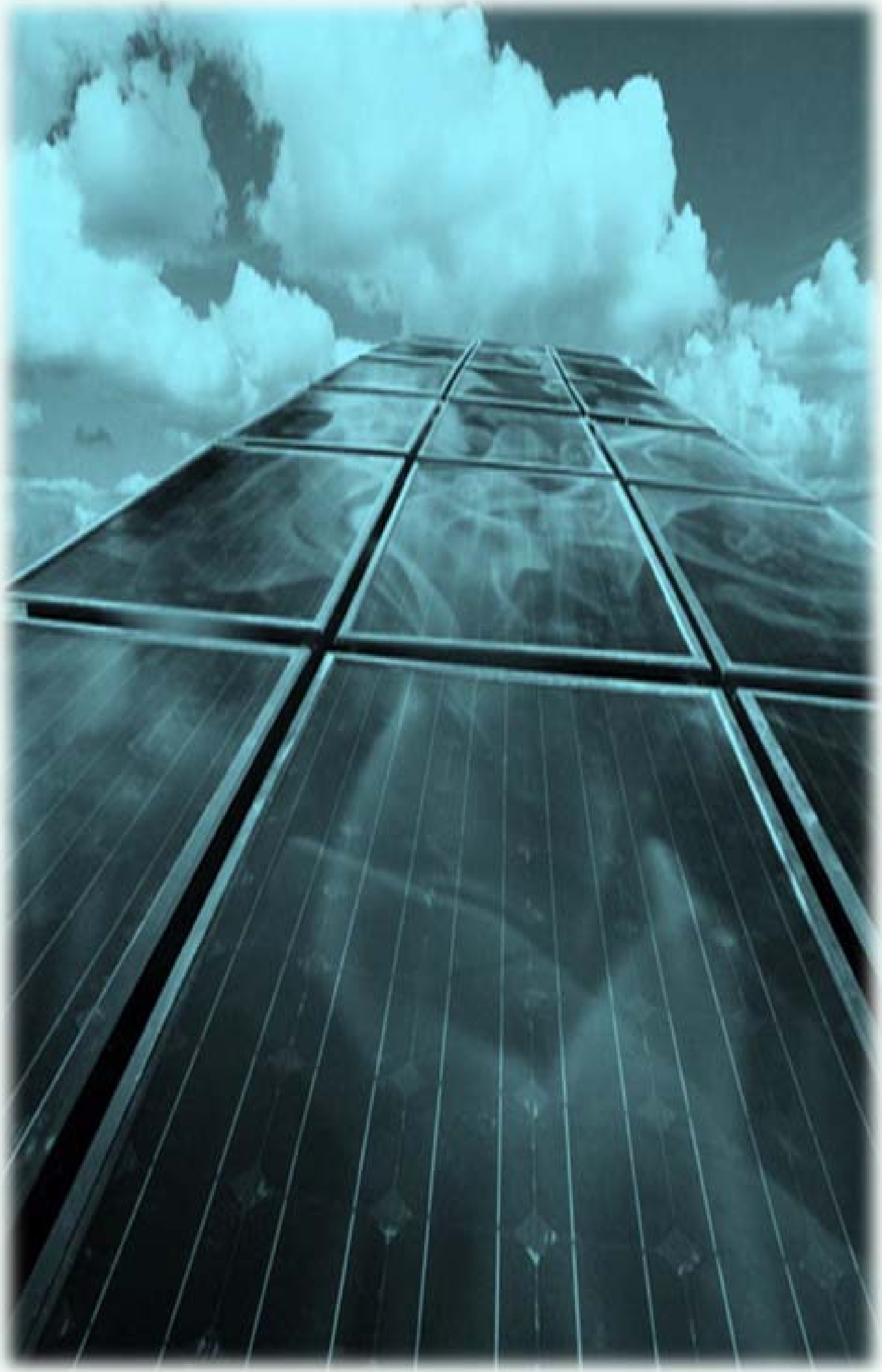

Freiburg, September 2013

Implementation of the Energy Performance of Buildings Directive (EPBD) – Which role for renewable heating?

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Buildings are key in reaching long-terms goals

- **Low-carbon Economy 2050 Roadmap**

GHG reduction vs. 1990	2005	2030	2050
Power	-7%	-54 to -68%	-93 to -99%
Industry	-20%	-34 to -40%	-83 to -87%
Transport	30%	+20 to -9%	-54 to -67%
Residential and services	-12%	-37 to -53%	-88 to-91%
Agriculture	-20%	-36 to -37%	-42 to -49%

- **Roadmap for a Resource-Efficient Europe 2050:** buildings influence **42%** of the final energy consumption, **35%** of the CO_2 emissions, **>50%** of all extracted materials and **30%** of water consumption.

- **Energy 2050 Roadmap:** "energy efficiency potential in new and existing buildings is key"

Energy Performance of Buildings Directive (31/2010/EU)

Energy performance & Cost optimality

- MSs: Minimum energy performance requirements
- Cost-optimal methodology (common framework)
- Requirements for technical building systems

Existing Buildings

- All the buildings undergo major renovation should implement energy efficiency measures
- Minimum requirements for buildings and components

New Buildings → **Nearly Zero Energy Buildings**

- By 31 Dec. 2018 public admin. buildings
- By 31 Dec. 2020 all buildings
- National plans for nZEB

Energy performance certification

- Implement EPC schemes
- Recommendation for cost-optimal improvements
- Independent control systems

HVAC inspection

- Regular inspections (heating > 20kW, AC>12kW)
- Independent control systems

Financial incentives & Market barriers

- MSs: to prepare lists of measures and instruments
- Take into account cost-optim. for these measures

Introduction of a new concept: nearly Zero-Energy Building (nZEB)

- A ‘nearly zero-energy building’ […] has a **very high energy performance (for HVAC, DHW, aux. equip. and lighting)**.
- The **nearly zero or very low amount of energy required** should be covered to **a very significant extent by energy from renewable sources, including on-site or nearby RES.** (EPBD, 2010)

EPBD recast → nZEB:

- All new buildings, by 31 December 2020
- All new buildings occupied and owned by public authorities, after 31 December 2018

RES Directive: EU MS have to introduce minimum requirements for RES for new buildings and renovation, by 31 December 2014

Challenge: To find the synergy between energy efficient demand and renewable generation

- **Efficiency** has its limits and it is not possible to drive energy demand down to zero
- **Renewable energy** has a price and there are local disparities

Need for a sustainable nZEB definition

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Need for a sustainable nZEB definition

Trias energetica principles	EPBD-nZEB and climate goals	BPIE proposals for nZEB definition: nZEB Principles	BPIE proposals for nZEB definition: nZEB Thresholds
Reduce the energy need	Very high ‘energy performance’, ‘low energy need’	Clear boundaries where the quality of energy need is defined	…for the maximum allowable energy need (fix threshold towards BAT)
Use renewable energy	Renewables to ‘a very significant extend’, incl. ‘on-site and nearby’	Clear boundaries where to measure renewable energy share	…for minimum renewable energy share (>50%)
Use less fossil fuels but efficient	2050 climate goals: nZEB ~ nearly zero carbon	Clear boundaries where primary energy and CO_2 emissions are calculated	…for the overarching primary energy and CO_2 emissions (<3kg/m^2/yr)

nZEB definitions and implementation roadmaps in EU MS

- **BPIE studies for Poland, Romania and Bulgaria**
- For SFH, MFH and office buildings
- Evaluation on simulated improvement options towards nZEB levels for new buildings
- Proposing affordable but ambitious nZEB definitions (aprox. 50kWh/m^2/yr, >40% RES, <3-7 kg CO_2/m^2/yr)
- Proposing policy implementation roadmaps by 2020

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Simulated nZEB variants and heating solutions

	Reference SFH	Reference MFH	Reference Office
V0	Reference	Reference	Reference
V1	+ mech. ventilation with heat recovery	+Improved building shell	+Improved building shell
V2	+ improved building shell	+Mech. ventilation with heat recovery	+Improved building shell + external shading
V3	+Improved building shell + improved mech. ventilation with heat recovery	+Improved building shell + mech. ventilation with heat recovery	+Improved building shell + external shading + improved lighting
V4	+Improved building shell + improved mech. ventilation with heat recovery + solar collectors	+Improved building shell + mech. ventilation with heat recovery + solar collectors	Close to Passive house standard
A	Wood pellet boiler	Wood pellet boiler	Central air/water heat pump
B	Air source heat pump	Air source heat pump	Central brine/water heat pump
C	Ground collector brine heat pump	Ground collector brine heat pump	Central wood pellet boiler
D	Gas condensing boiler	Gas condensing boiler	Central gas condensing boiler
E		District heating	District heating

Additionally: with and without CO_2 compensation (by a rooftop PV system)

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SFH in Bulgaria – simulation results

Variants	Final specific demand [kWh/m2/yr]	Without CO_2 compensation: Primary energy demand [kWh/m²/yr]	CO_2 emissions [kgCO_2/m²/yr]	Renewable share [%]	Total additional annualised costs [Euro/m²/yr]	With CO_2 compensation (by additional PV): Primary energy demand* [kWh/m2/yr]	CO_2 emissions [kgCO_2/m²/yr]	Renewable share [%]	Total additional [illegible] costs
V0 - Reference	169.9	86.4	45.1	90%	0	n.a.	n.a.	n.a.	[illegible]
V1 - Air heat pump	25.5	51.1	6.4	35%	[illegible]	0	0	[illegible]	[illegible]
V1 - Brine heat pump	21.2	42.5	5.4	35%	[illegible]	0	0	[illegible]	[illegible]
V1 - Bio boiler	91	21.9	0.5	99%	-4.20	11.0	0	104%	[illegible]
V1 - Gas boiler	[illegible]	[illegible]	[illegible]	1%	[illegible]	66.4	[illegible]	37%	[illegible]
V2 - Air heat pump	19.4	39	4.9	35%	[illegible]	0	0	135%	[illegible]
V2 - Brine heat pump	15	28.9	3.8	35%	-4.95	0	0	135%	[illegible]
V2 - Bio boiler	[illegible]	[illegible]	0.5	[illegible]	[illegible]	8.4	0	[illegible]	[illegible]
V2 - Gas boiler	[illegible]	70.4	14.4	[illegible]	5.23	26.1	7.2	39%	1.52
V3 - Air heat pump	20.8	41.8	5.3	35%	-6.70	0	0	135%	-5.82
V3 - Brine heat pump	18.1	36.4	4.6	35%	-5.69	0	0	135%	-3.3
V3 - Bio boiler	72.1	16.0	0.6	98%	-2.96	8.5	0	105%	-2.20
V3 - Gas boiler	72.1	81.6	14.2	1%	[illegible]	15.9	6.4	47%	0.23
V4 - Air heat pump	15.6	31	3.9	35%	-7.12	0	0	135%	-4.99
V4 - Brine heat pump	13.5	27.1	3.4	35%	-4.85	0	0	135%	-2.99
V4 - Bio boiler	49.4	13.2	0.5	98%	-2.75	2.9	0	108%	-2.04
V4 - Gas boiler	49.4	55.9	10.1	1%	-3.51	9.7	1.8	[illegible]	[illegible]
	<40	<40	<4	>50	<5	<40	<4	>50	<5
	40<x<60	40<x<70	4<x<7	30<x<50	5<x<10	40<x<70	4<x<7	30<x<50	5<x<10
	[illegible]	>70	>7	<30	>10	>70	>7	[illegible]	>10

+ solar collectors

With additional PV

↓

All solutions cost-effective

-7.12
-4.85
-2.75
-3.51

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Implementing the cost-optimal methodology in EU countries – BPIE study

- To offer **additional guidance** to MS on how to implement the cost-optimal methodology, based on practical case studies for Austria, Germany and Poland
- To highlight the **links between cost-optimality and nZEB**
- To highlight the stringency of **aligning building regulations with long term climate goals**

What is the cost-optimal requirement?

EPBD introduced **a common framework methodology** for MS on how **to set energy performance requirements for buildings** by **considering the economic aspects (global costs)** as a driver for improving technical building codes

- **Rationale:**

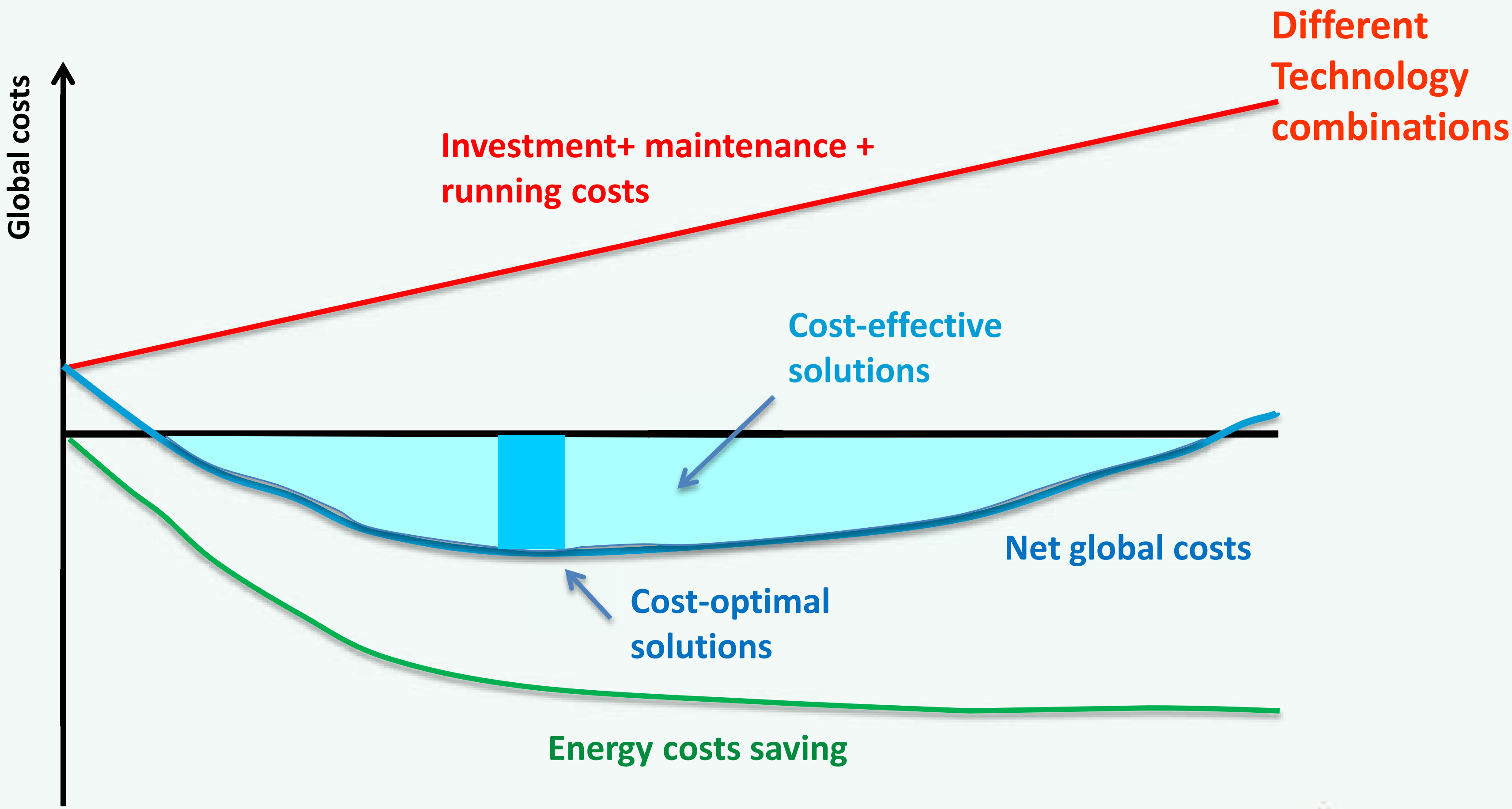
Equivalent level of ambition in all MS, but no harmonised requirements

- **Aims:**

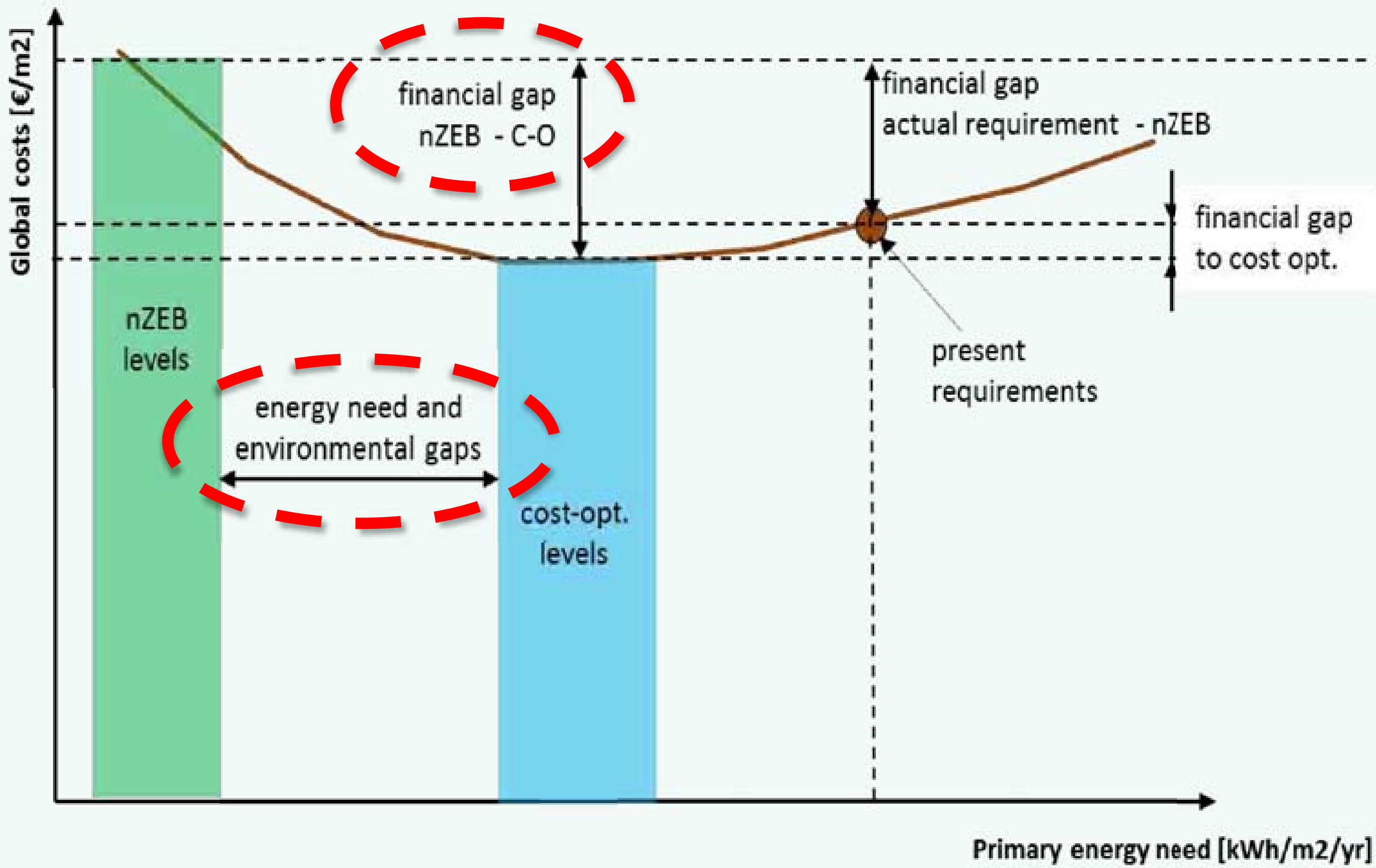
-Shift focus from upfront investment costs to global life cycle costs (including energy costs)

-Tightening the building codes for new buildings and renovation of the existing buildings

Cost-optimal and cost-effective



Cost-optimality as a tool for evaluating nZEB

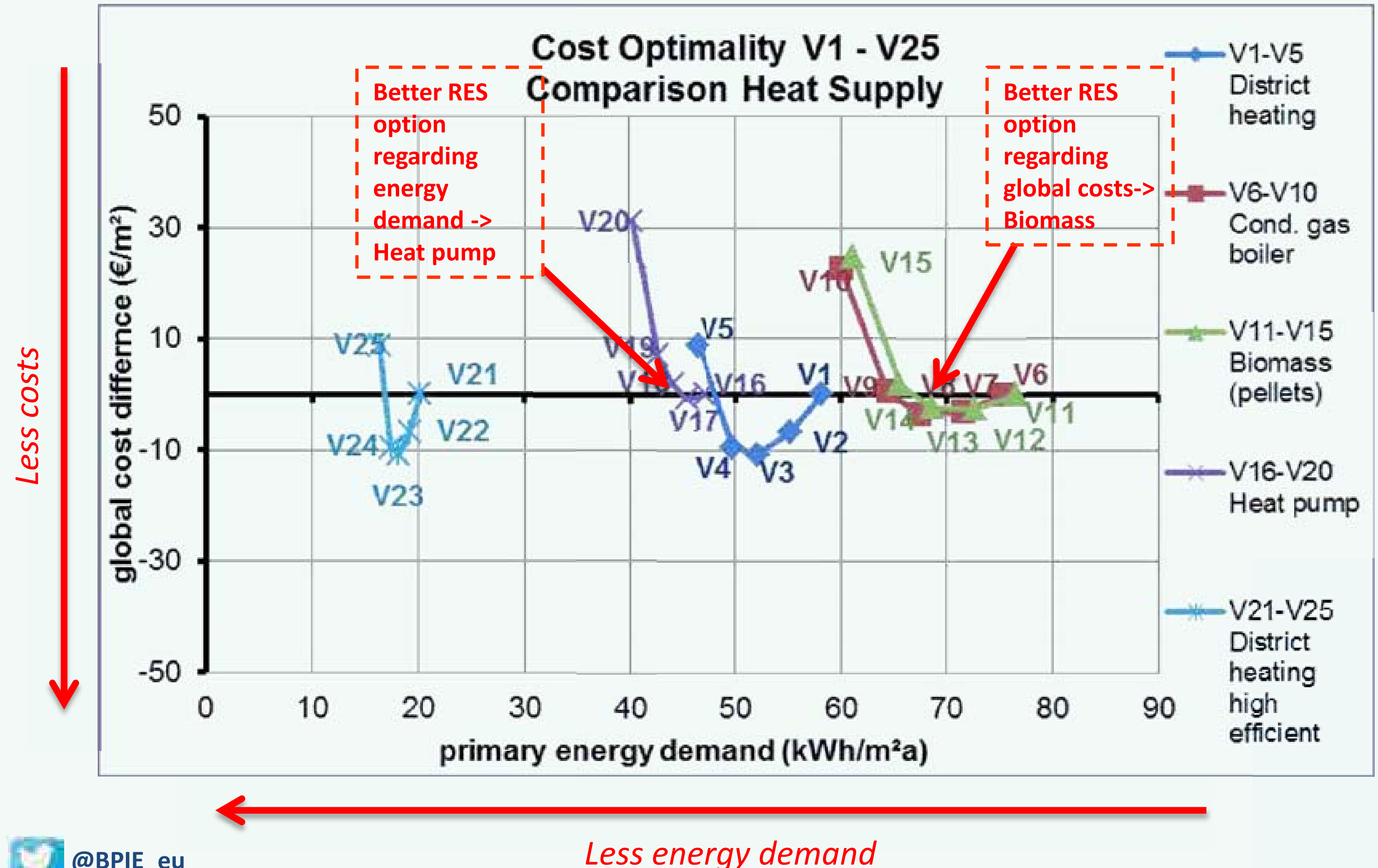


Example: cost-optimality in Austria (for MFH)

- Altogether **50 different technical variants** have been defined
- Elements of differentiation as follows:
  - **Insulation standards:** Five different levels actual minimum requirement (NHD-line 16) → passive house (NHD-line 8)
  - **Heat supply:** district heating→ gas condensing boiler, **biomass boiler**, heat pump, highly efficient district heating
  - **Insulation material:** EPS → mineral rock wool
  - **Share of window area:** 20% in basic case → 4 additional variations
  - **Ventilation system:** in combination with high insulation standards → (partly) abandonment of static heating system (radiators in the flats) improved airtightness levels
  - **Solar system:** **solar-thermal only → combination of solar-thermal and PV**

Results reference scenario Austria:

Different energy supply systems



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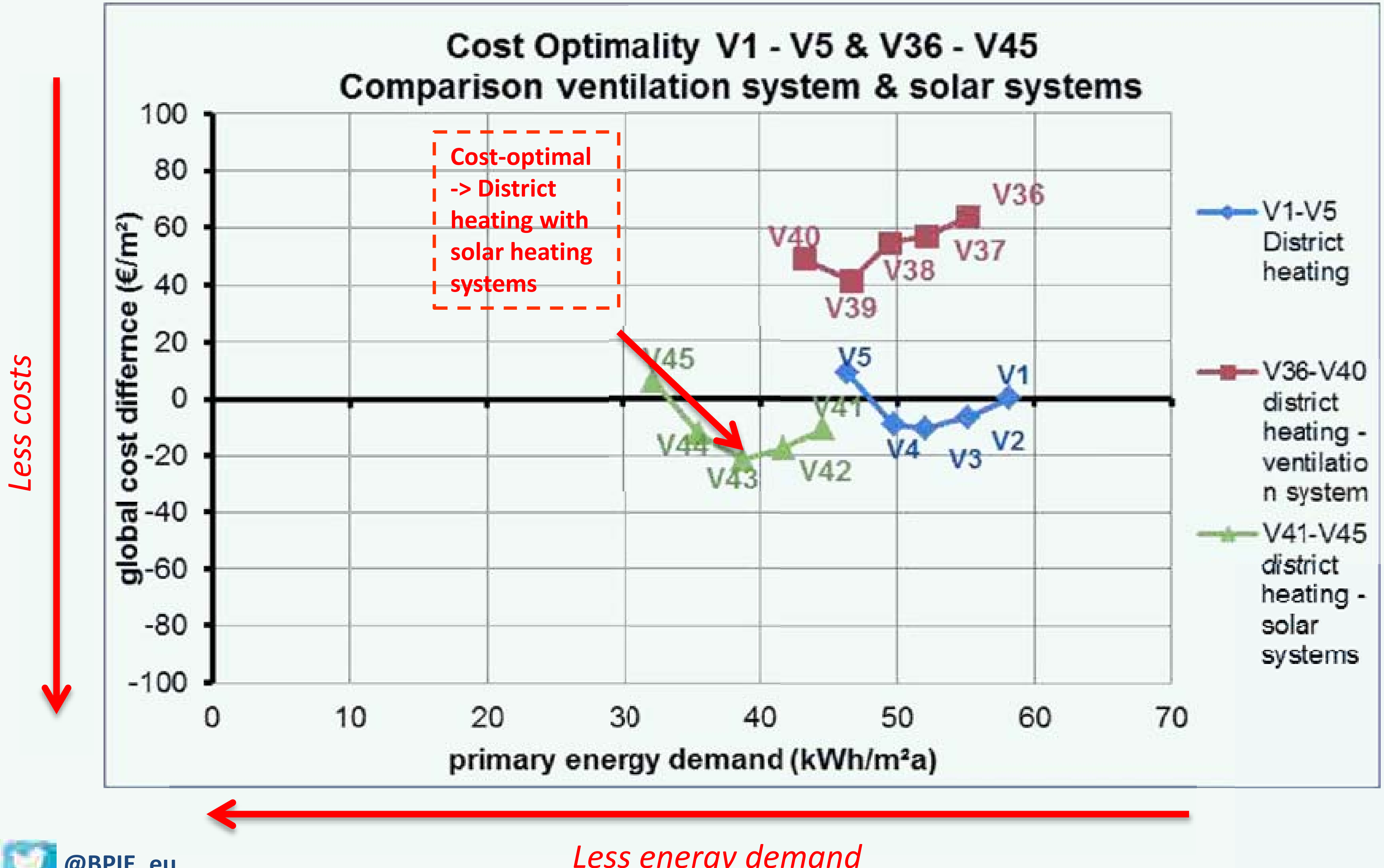
Results reference scenario Austria:

Different ventilation and solar systems



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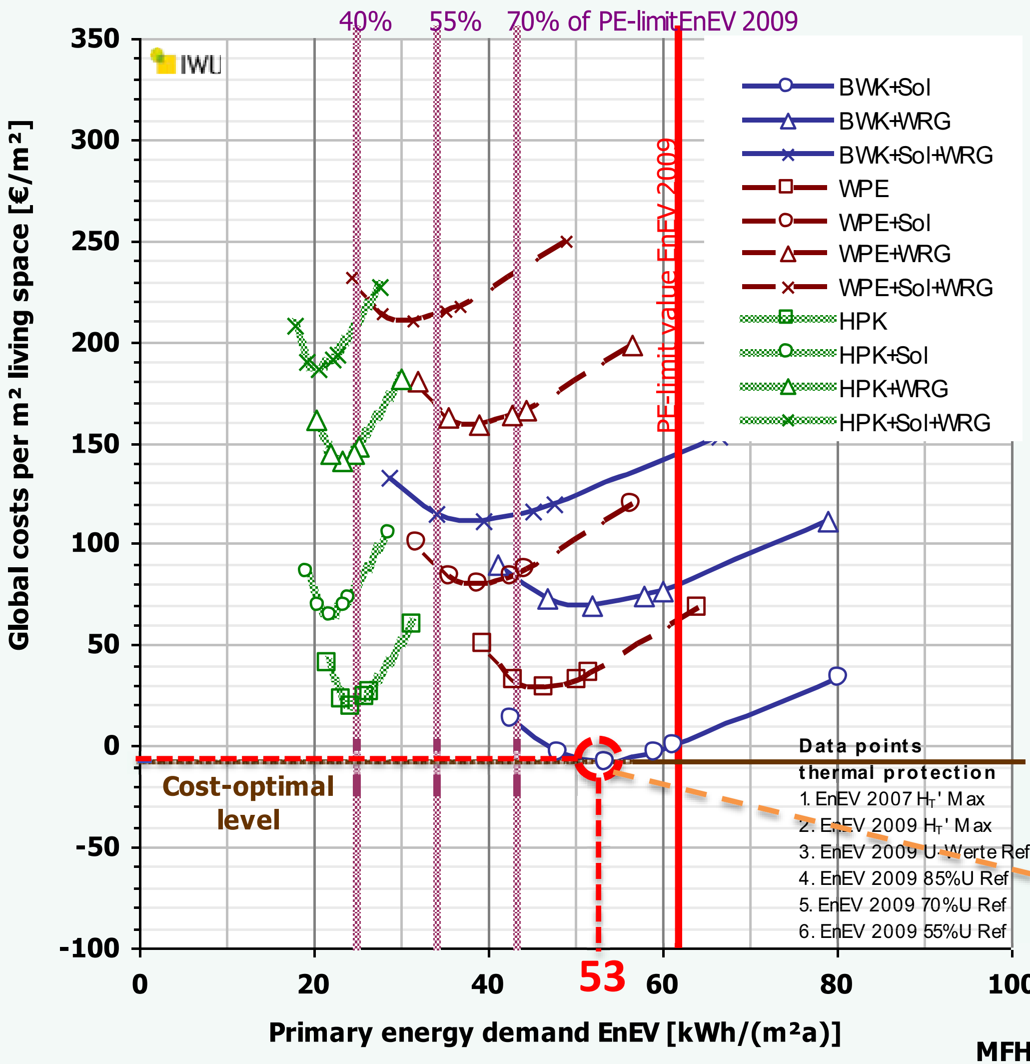
Example: cost-optimality in Germany (for SFH & MFH)

Standard	Variant 1	Variant 2	Variant 3: Reference case	Variant 4	Variant 5	Variant 6
Thermal protection	EnEV 2007 HT' Max $\leq H'_{T,zul}$ according EnEV 2007	EnEV 2009 HT' Max $\leq H'_{T,zul}$ according EnEV 2009	EnEV 2009 U Ref U-Values EnEV 2009 reference building	EnEV 2009 U Ref 85% 85% of "EnEV 2009 U Ref"	EnEV 2009 U Ref 70% 70% of "EnEV 2009 U Ref"	EnEV 2009 U Ref 55% 55% of "EnEV 2009 U Ref" (≈ U-values of passive house)

Measures acronyms	Heat supply systems
BWK	Condensing boiler (gas)
BWK+Sol	Condensing boiler (gas) + solar heating system
BWK+WRG	Condensing boiler (gas) + ventilation system with heat recovery
BWK+Sol+WRG	Condensing boiler (gas) + solar heating system and ventilation system with heat recovery
WPE	Electric heat pump / heat source soil
WPE+Sol	Electric heat pump / heat source soil with solar heating system
WPE+WRG	Electric heat pump / heat source soil with ventilation system with heat recovery
WPE+Sol+WRG	Electric heat pump / heat source soil with solar heating system and ventilation system with heat recovery
HPK	Wood pellets boiler
HPK+Sol	Wood pellets boiler + solar heating system
HPK+WRG	Wood pellets boiler + ventilation system with heat recovery
HPK+Sol+WRG	Wood pellets boiler + solar heating system + ventilation system with heat recovery

Results for Germany: Global cost levels MFH

Financial perspective



- Cost-optimal level MFH: approx. **53 kWh/(m²a)**
- Current requirements of EnEV 2009 do not yet achieve the cost-optimal level
- Tightening by about **15 %** (MFH) possible
- Additional cost of nZEB (EB40): **41 €/m²**

Cost-optimal achieved by condensing boiler and solar heating system

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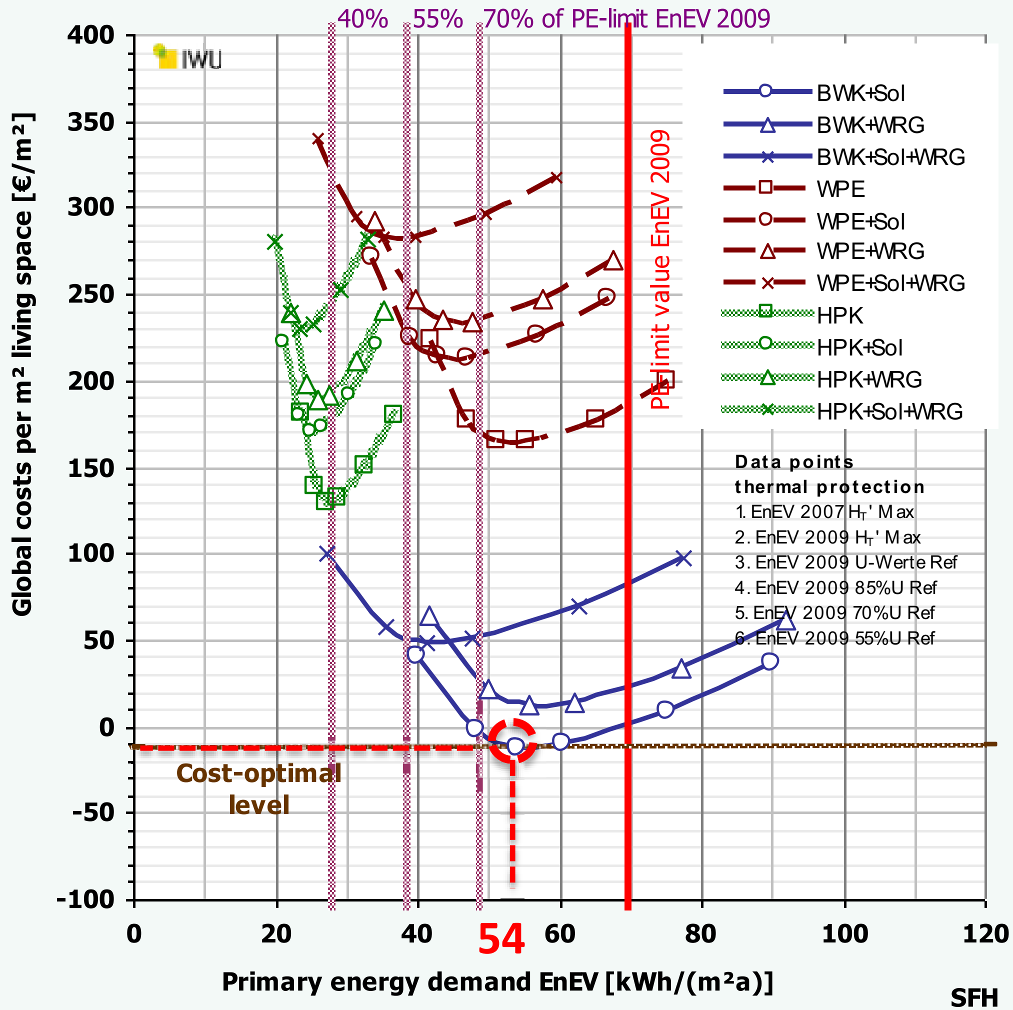
Results for Germany: Global cost levels SFH

Financial perspective



- Cost-optimal level SFH: approx. **54 kWh/(m²a)**
- Current requirements of EnEV 2009 do not yet achieve the cost-optimal level
- Tightening by about **25 %** (SFH) possible
- Additional cost of nZEB (EB40): **101 €/m²,** compared to EnEV09 (=0 €/m²)

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Moving towards nearly zero-energy buildings

Important considerations

- **A paradigm shift**: from investment costs to lifetime assessment of the building costs
- Recent BPIE studies reveal that **nearly zero-energy buildings do not induce high additional costs**:
  - 2-8% additional cost as comparing to actual practice in Germany
  - Up to 0.15 euro/m^2 in Austria (compared to actual operational cost of 0.5-1.5 euro/m^2)
  - Cost effective options in Poland, Bulgaria and Romania
- **Renewables are cost-effective solutions** to heat and cool buildings, in particular if these buildings have low energy demand

Moving towards nearly zero-energy buildings

Holistic solutions are needed

- A zero-energy buildings future cannot be reached **exclusively** either by energy efficiency improvements or renewable energy options
- **Exploit synergies** to achieve realistic and optimal solutions, adaptable to varied climate and affordable at varied purchase power

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Thank you!

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