TALLINNA
TEHNIKAÜLIKOOL

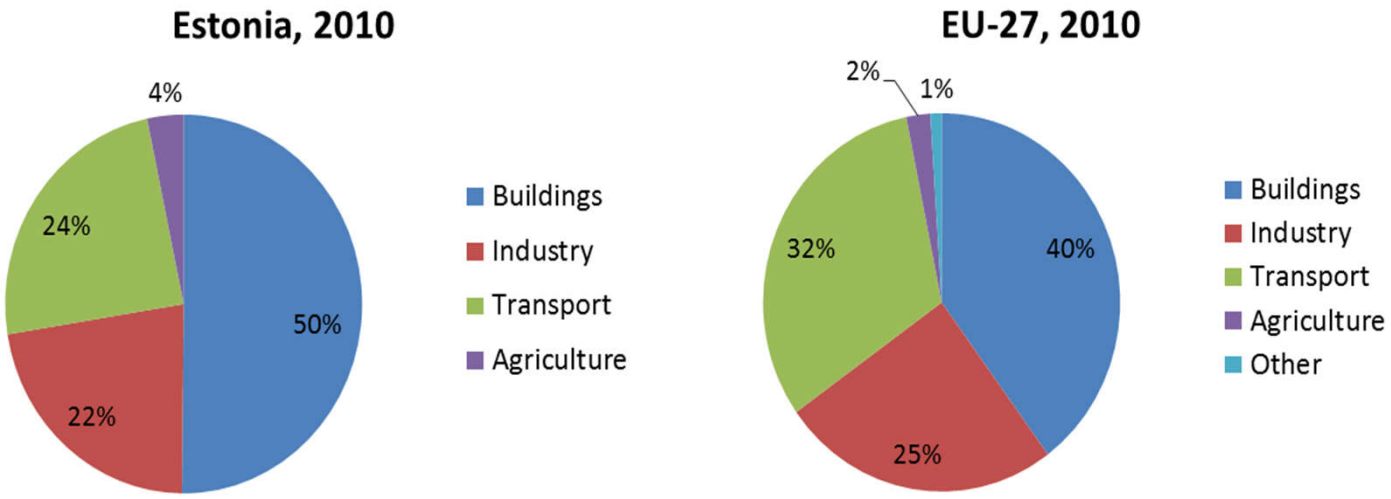
Hoonete energiatõhususe ja liginullenergia olukord Eestis ja Euroopas ning tulevikuperspektiiv uuendatud direktiivi kontekstis

14.11.2018 EKVÜ koolitus Tallinnas

Jarek Kurnitski

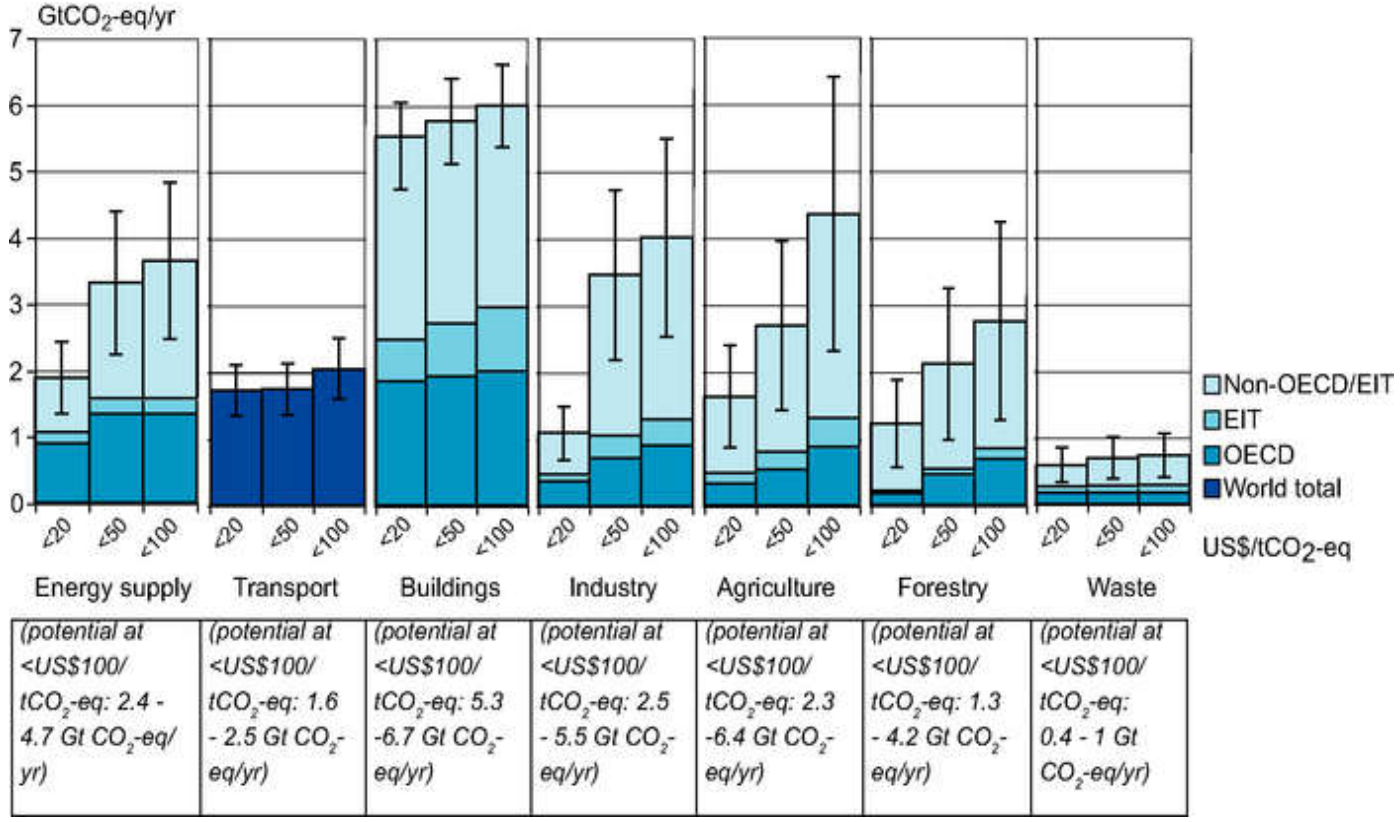
Hoonete energiakasutus on ebaproportsionaalselt suur

- Energia lõpptarbimine Eestis ca 33→32 TWh/a (2010–2015)
- Hoonete osakaal kasvamas üle 50% (ilma tööstushooneteta)
- EL keskmine 40%



http://www.energiatalgud.ee/img_auth.php/c/c1/ENMAK-Hoonete-uuring-20.09.2013.pdf

IPCC: Hoonetes on globaalselt majanduslikult kõige suurem potentsiaal



- http://www.ipcc.ch/publications_and_data/ar4/wg3/en/contents.html
- http://www.ipcc.ch/publications_and_data/ar4/wg3/en/spmsspm-c.html
- Hoonete energiatõhusus on globaalselt kõige suurem ja kõige soodsam sektor emissioonide vähendamiseks

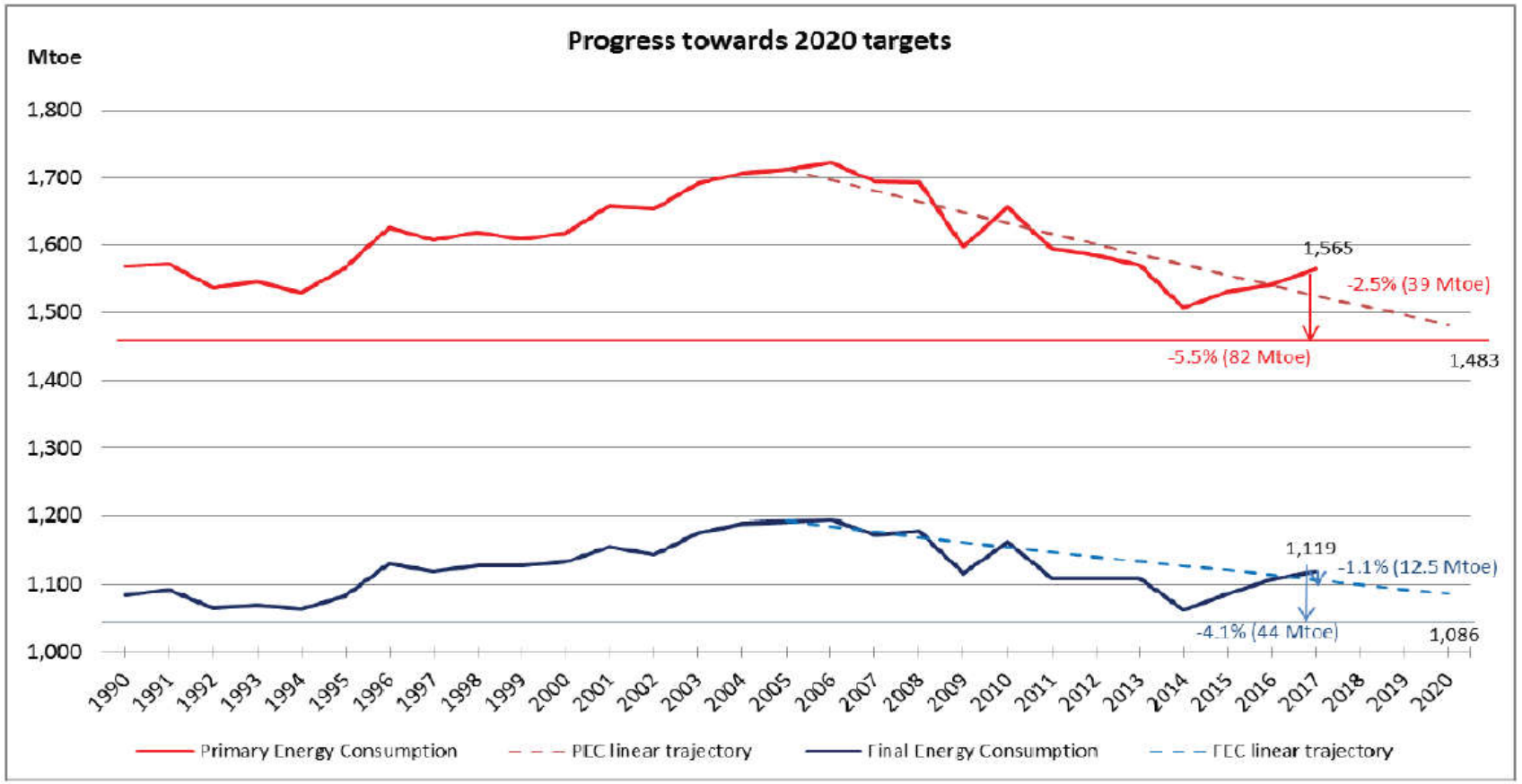
Commitment of European Union to low-carbon economy

"20-20-20" policy adopted in 2007 with three key objectives for 2020:

- 20% reduction in greenhouse gas emissions from 1990 levels
- Raising the share of EU energy sources from renewable resources to 20%
- 20% improvement in the EU's energy efficiency (20% primary energy saving from 2005 projection)

Energy efficiency (EE) target

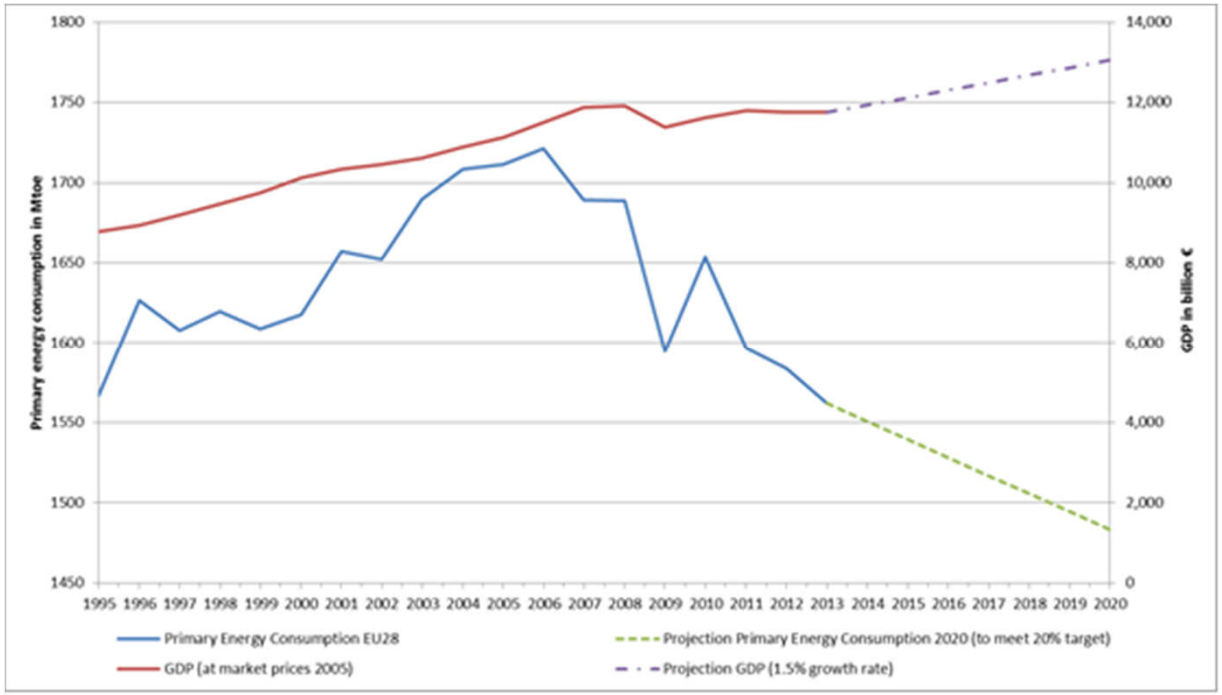
- Measured from the 2005 projection without energy saving measures
- 20% reduction from this projection by 2020



State of play: Energy Efficiency

The energy efficiency of the EU economy is steadily increasing.

Economic growth is being decoupled from energy consumption.



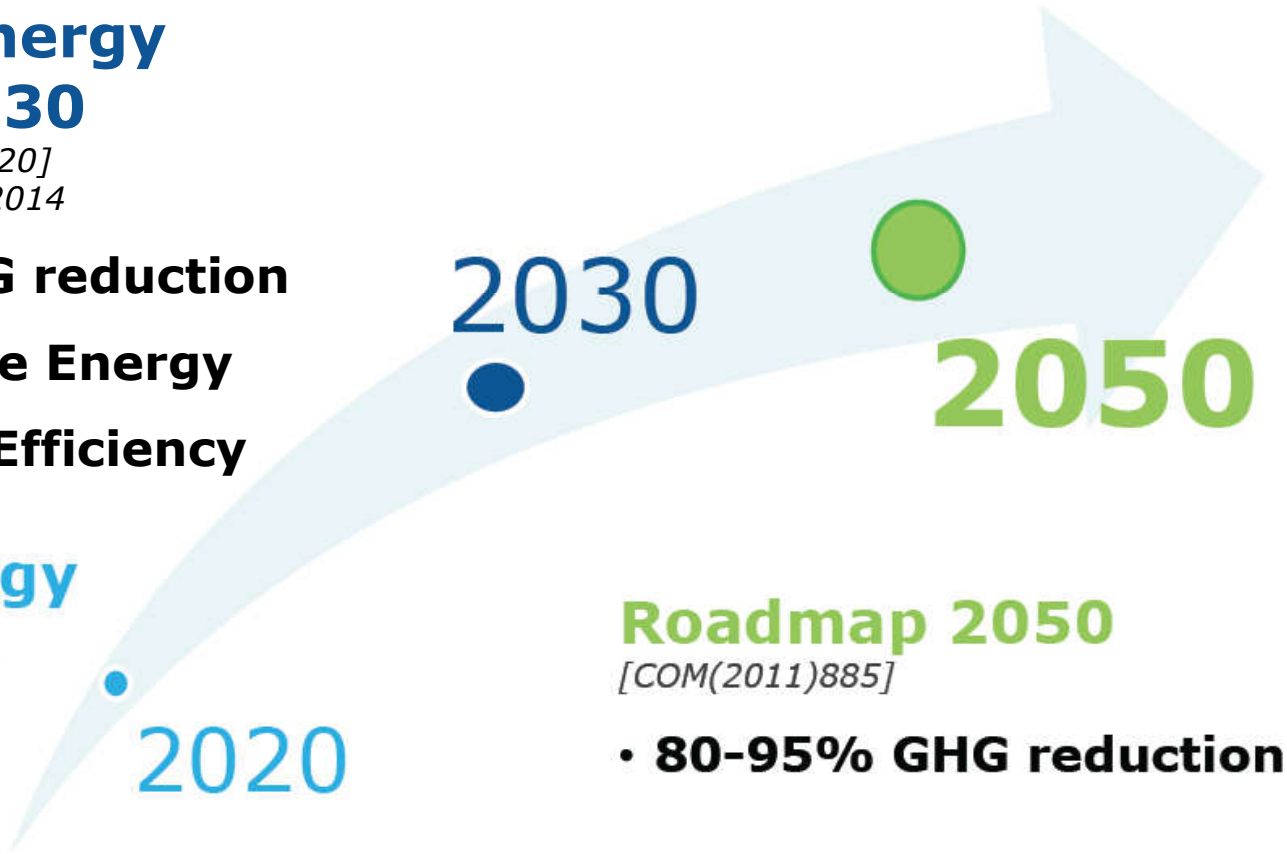
Source: Energy Efficiency Communication 2014 – COM(2014) 520

Climate and Energy Framework

Climate and Energy Framework 2030

[COM(2014)15&COM(2014)520]
European Council 23-24/10/2014

- **40 (45?)% GHG reduction**
- **32% Renewable Energy**
- **32.5% Energy Efficiency**



Climate and Energy Framework 2020

[COM(2010)639]

- **20% GHG reduction**
- **20% Renewable Energy**
- **20% Energy Efficiency**

Roadmap 2050

[COM(2011)885]

- **80-95% GHG reduction**

Legislative actions in EU to reach the targets

Energy Performance of Buildings Directive – EPBD 2002, 2010, 2018

Improvement of energy performance of buildings - targets in kWh/m^2 primary energy

Ecodesign of Energy Related Product - ErP 2005, 2009

Energy efficiency of energy using products, minimum efficiency

Renewable energies directive (RES) – 2009

Increase the use of renewables up to 20%, biofuels up to 10% in EU

Ecolabeling 2000 and Energy labeling 2010 directives

Energy classes A…. G in label, ecolabel for best product

Energy efficiency directive – EED 2012, review 2017

District heating, CHP, renovation 3%/a, public procurement, public buildings as model

MAJANDUS- JA KOMMUNIKATSIOONI-MINISTEERIUM

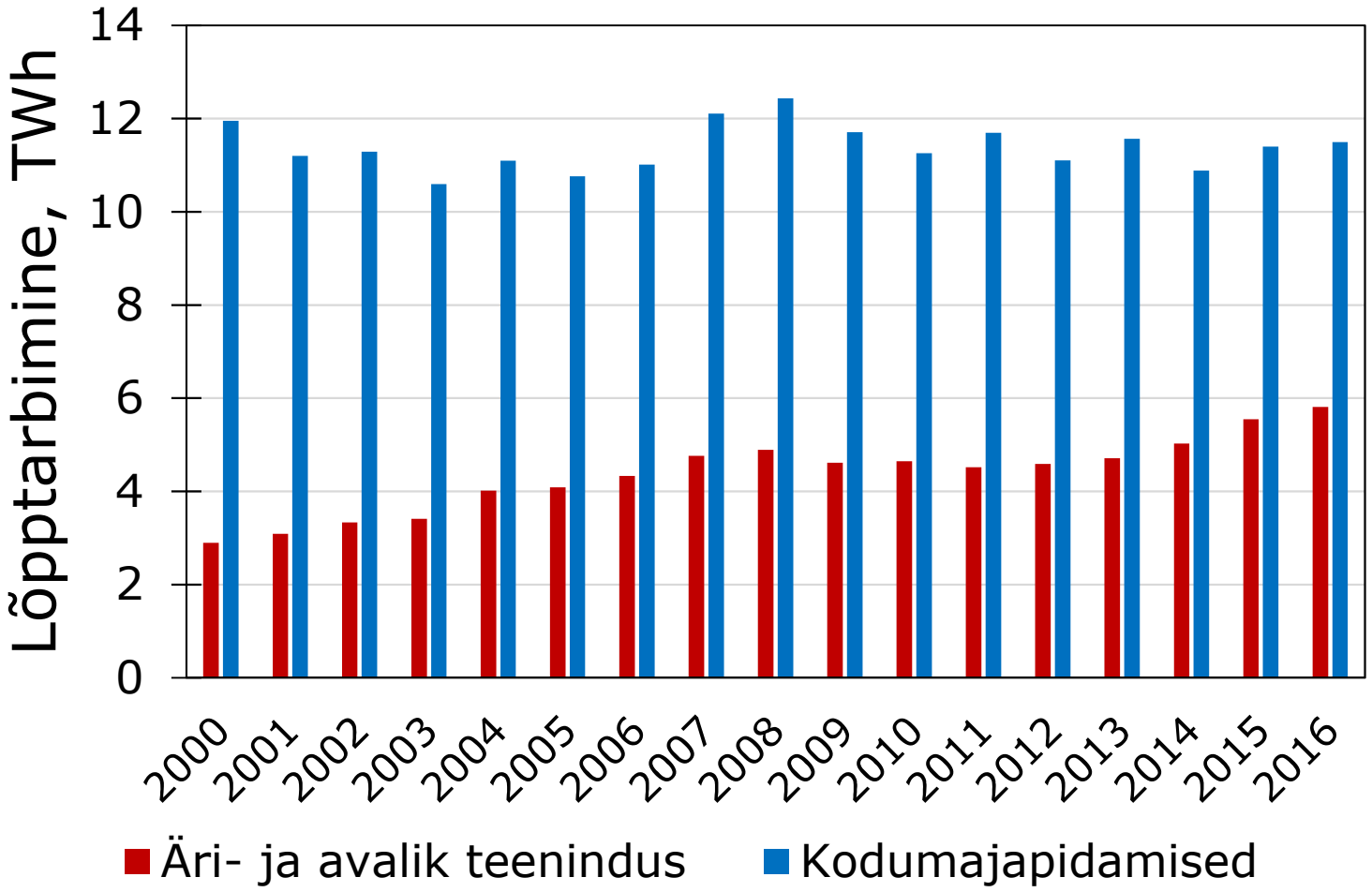
Koostamisel riiklik energia- ja kliimakava aastani 2030 (REKK 2030)

(EL energialiidu ja kliimameetmete juhtimise määrus)

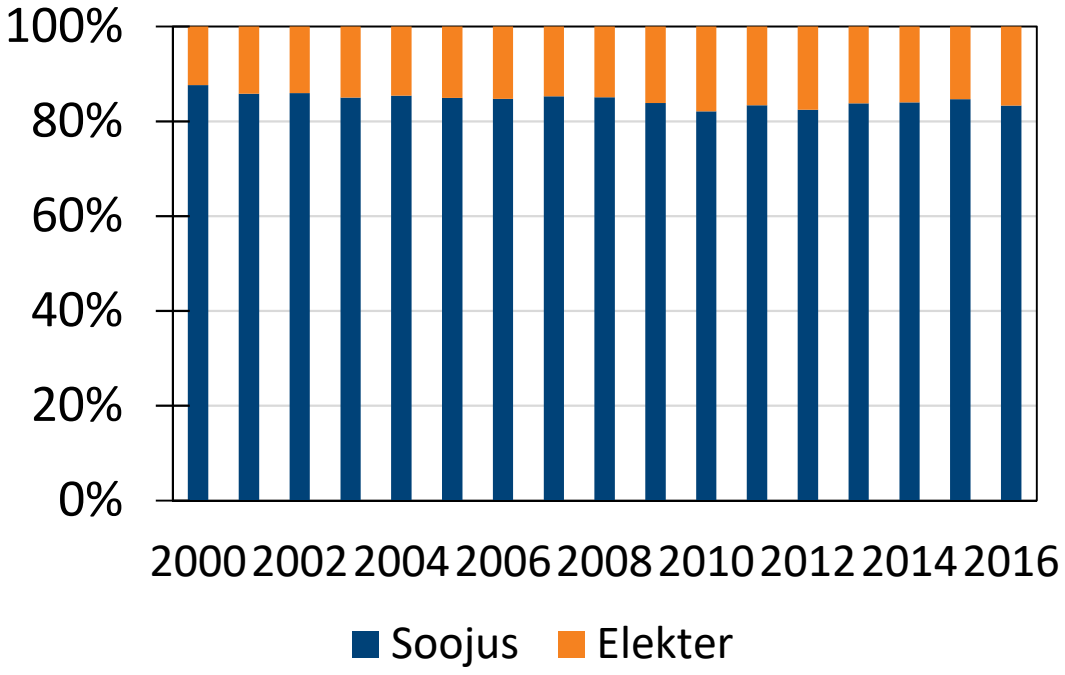
- annab ülevaate Eesti kliima- ja energiapoliitikast aastani 2030, ei eelda uue strateegi koostamise protsessi algatamist
- Ülevaate aluseks on
  - Kliimapoliitika põhialused aastani 2050 (kinnitanud Riigikogu aprillis 2017)
  - Energiamajanduse arengukava aastani 2030 (heaks kiidetud Vabariigi Valitsuses oktoobris 2017)
- Peab andma vastuse, mis on Eesti panus EL 2030 eesmärkide täitmisel
  - EL energiatõhususe eesmärk: **32,5%** prognoositust tõhusam energiakasutus aastaks 2030
  - EL taastuvenergia eesmärk: **32%** lõpptarbitavast energiast taastuvenergia aastaks 2030
- Meetmed, mille abil täidame perioodi 2021-2030 üldise energiatõhususkohustuse
  - Energiasäästule suunatud tegevuste ligikaudne tulem ajavahemikus 2021-2030 peab olema **14,5 TWh**

Energia lõpptarbimine 2000-2016

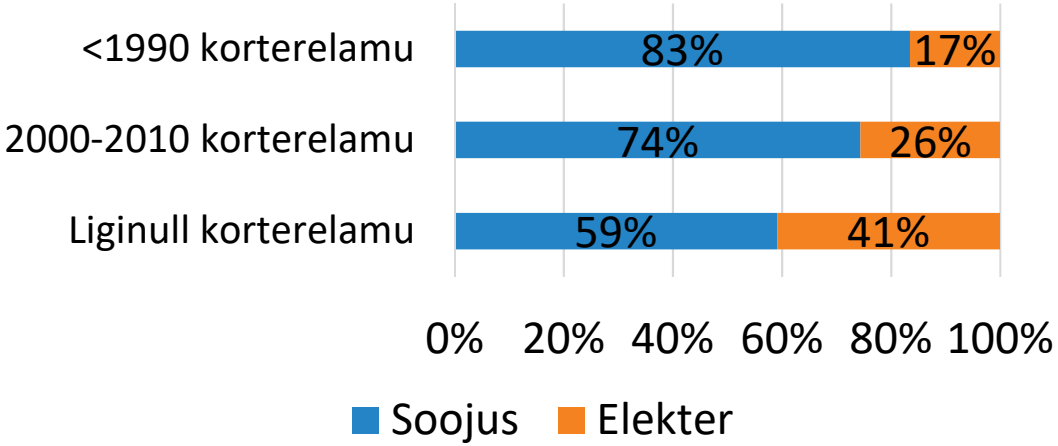
- Kodumajapidamiste lõpptarbimine suhteliselt stabiilne 11…12 TWh/a
- Äri- ja avaliku teeninduse lõpptarbimine 2x tõusnud (3→6 TWh/a)



Energia lõpptarbimine: kodumajapidamised

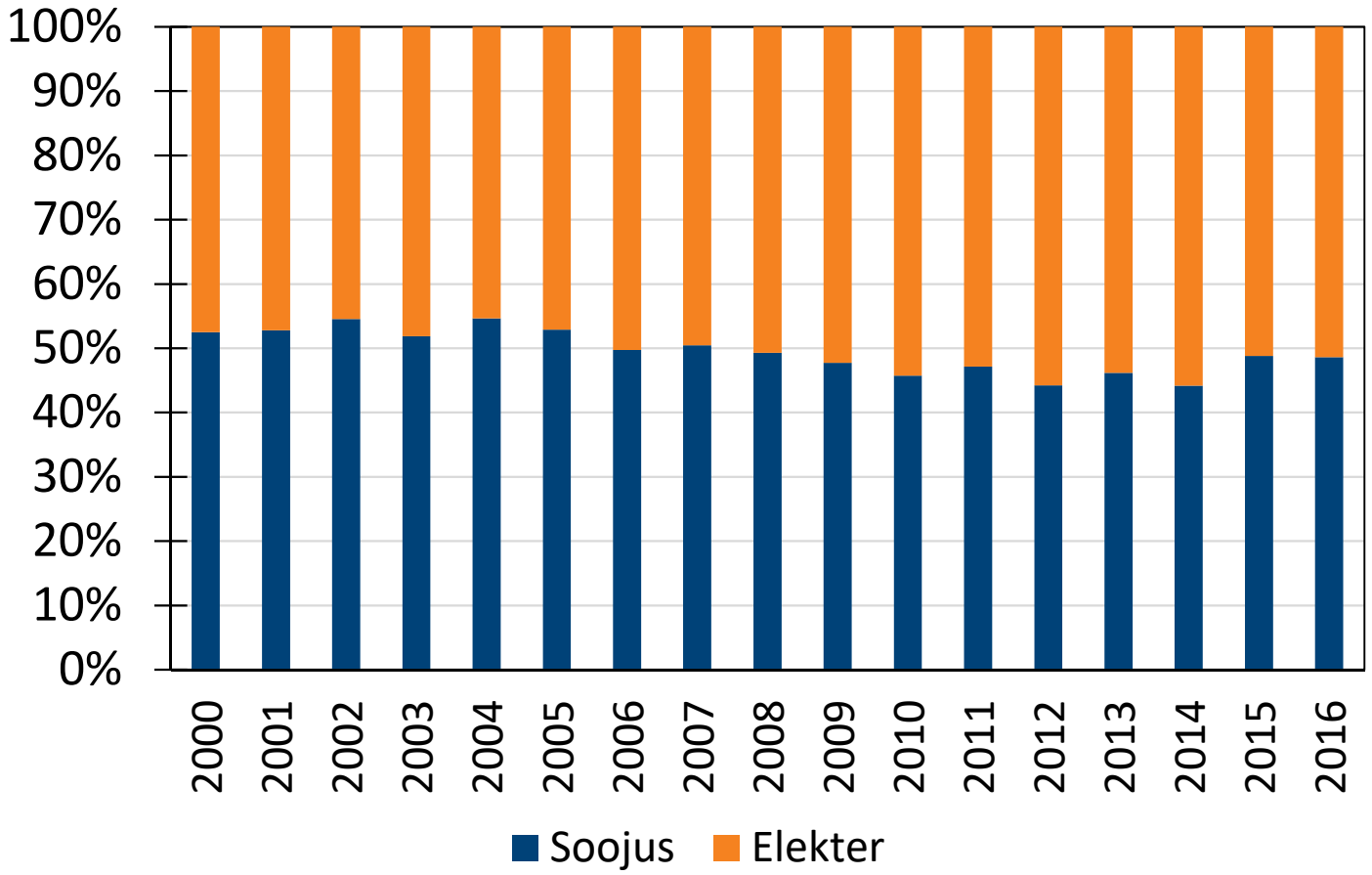


- Soojusenergia osakaal üle 80%
- Elektri osakaal vaikselt tõusmas



Energia lõpptarbimine: äri- ja avalik teenindus

- Elektri osakaal ≈ 50%
- Elektri kasutus on suurenenud ≈1,5 TWh/a



EPBD eesmärgid

- Energeetiline turvalisus
- Energiavarustuse kindluse tagamine
- Tööhõivevõimalused
- Konkurentsivõime
- Võrdne piirkondlik areng



EPBD-st tulenevad printsiibid

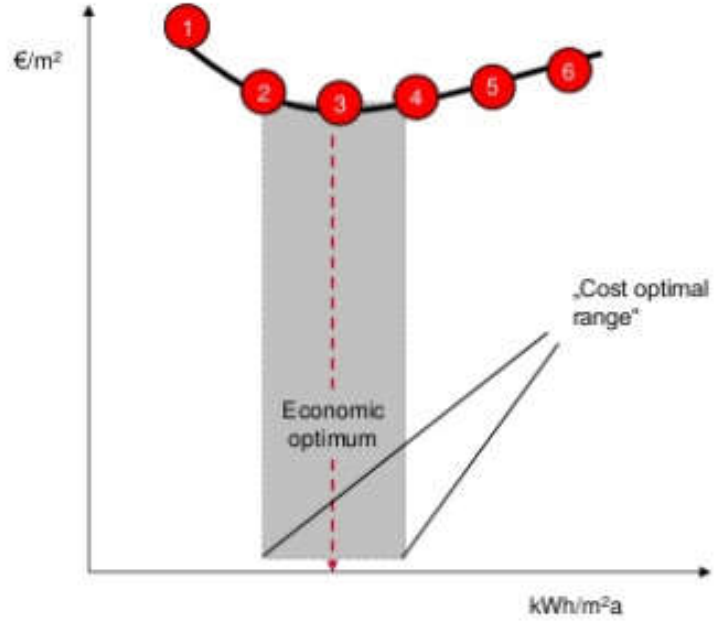
- Energiatõhususe nõuded kehtivad uute hoonete püstitamisel ja olemasolevate hoonete olulisel rekonstrueerimisel.
- Energiatõhususe miinimumnõuded on kulutõhusad – tuleb saavutada vähim alginvesteeringu ja püsikulude summa hoone kasutusaja jooksul.
- Energiatõhususe nõudeid uuendatakse pidevalt.
- Energiatõhususe näitaja põhineb primaarenergiatarbimisel.
- Hoone energiatõhusust ei tohi saavutada sisekliima arvelt.

Kulutõhusus – kuluoptimaalsus – energiatõhususe alustala

EPBD 2nd recast 2018/844/EU (2010/31/EU) – Nearly zero energy buildings NZEB

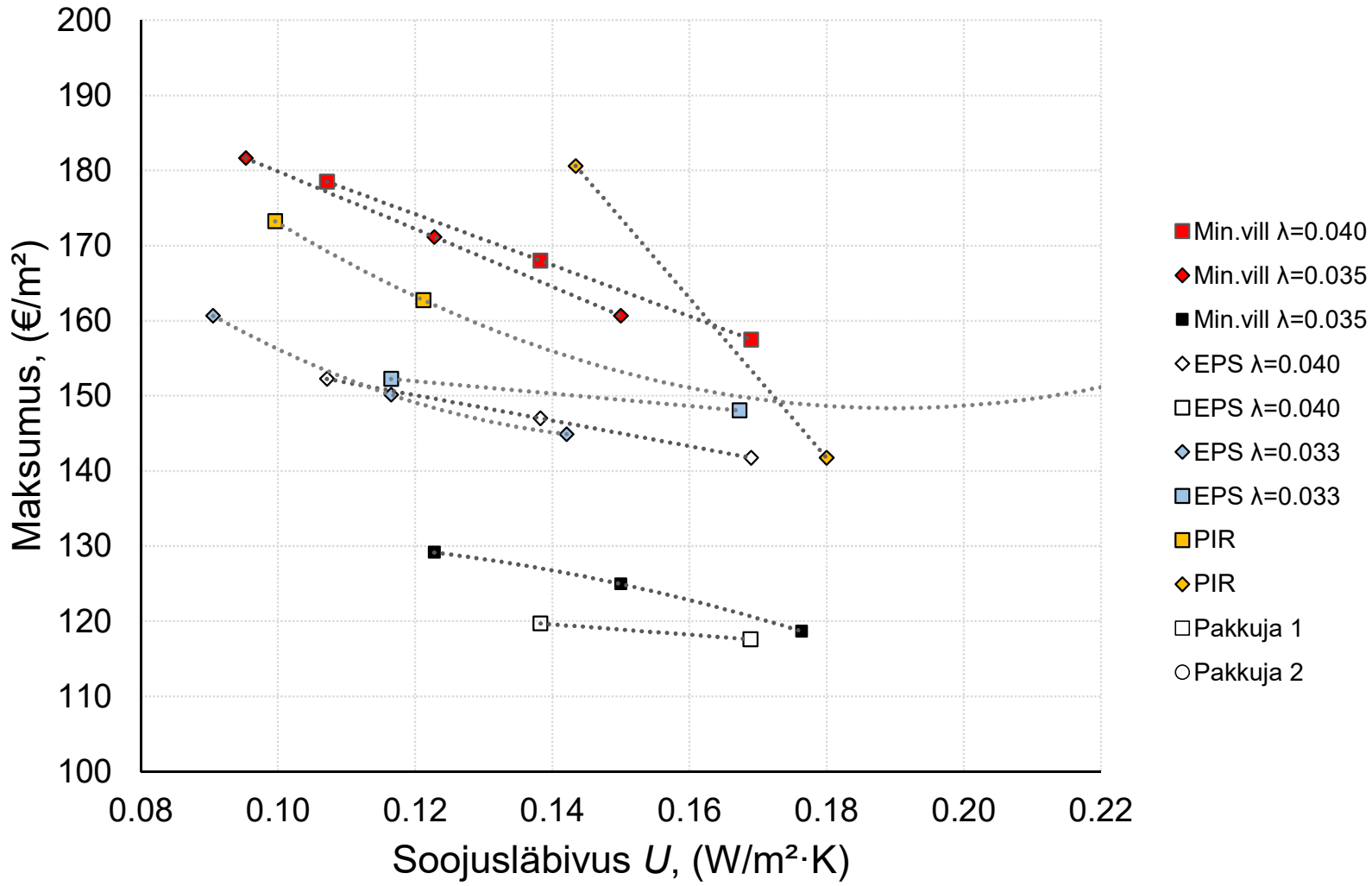
- **No change in NZEB = very high energy performance + significant extent renewable energy produced on-site or nearby**

- Definition of "a very high energy performance " and "significant extent of renewable energy" let for Member States, but the **cost-optimality** principle has to be followed.



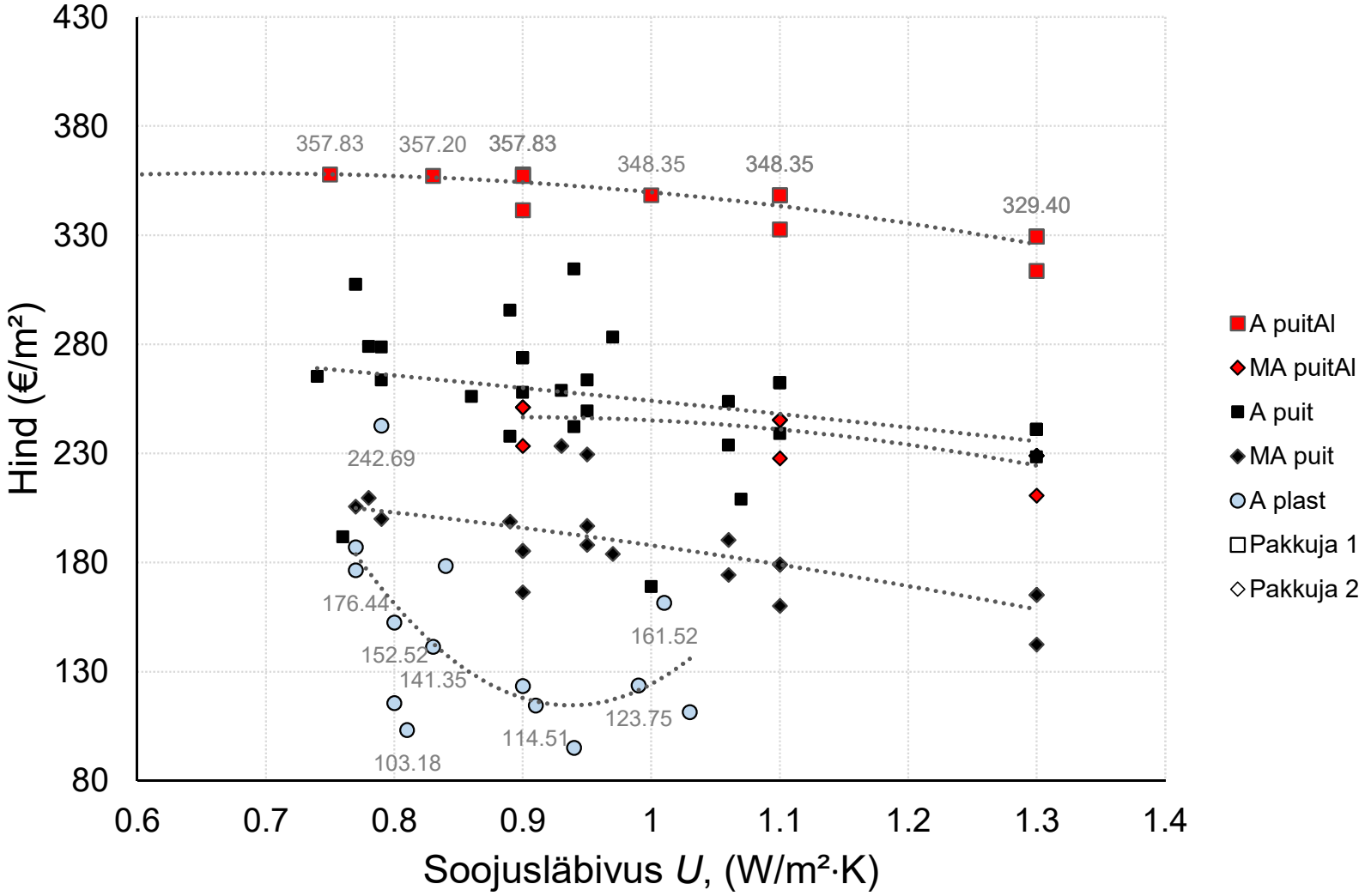
Liginullenergia maksumused

- Betoonelementsein: maksumus lisandub, kuid mõõdukalt



Liginullenergia maksumused

- Akende maksumusel nõrk seos energiatõhususega

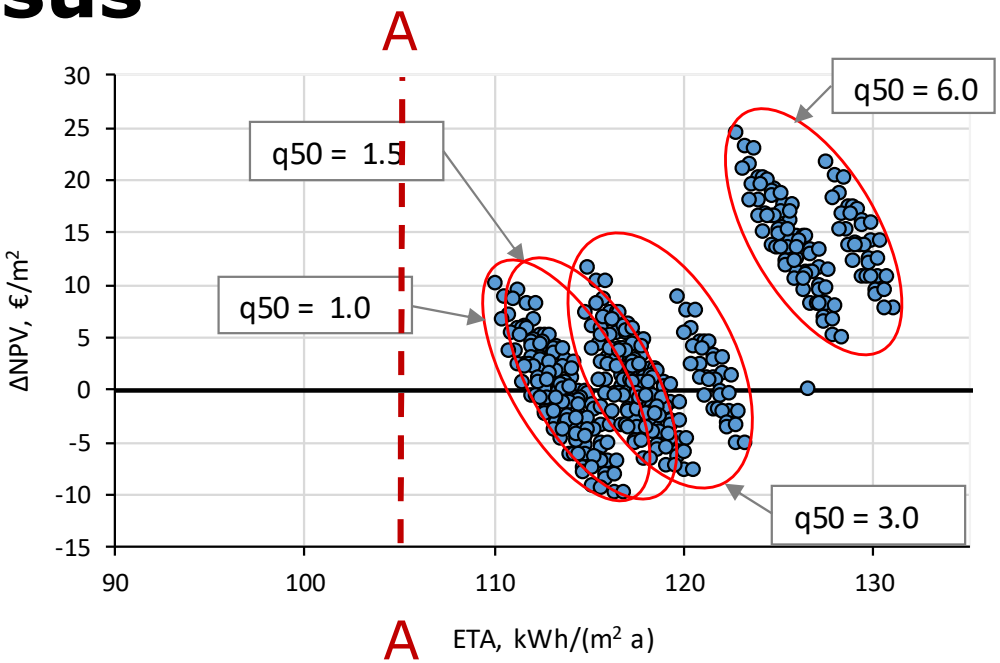


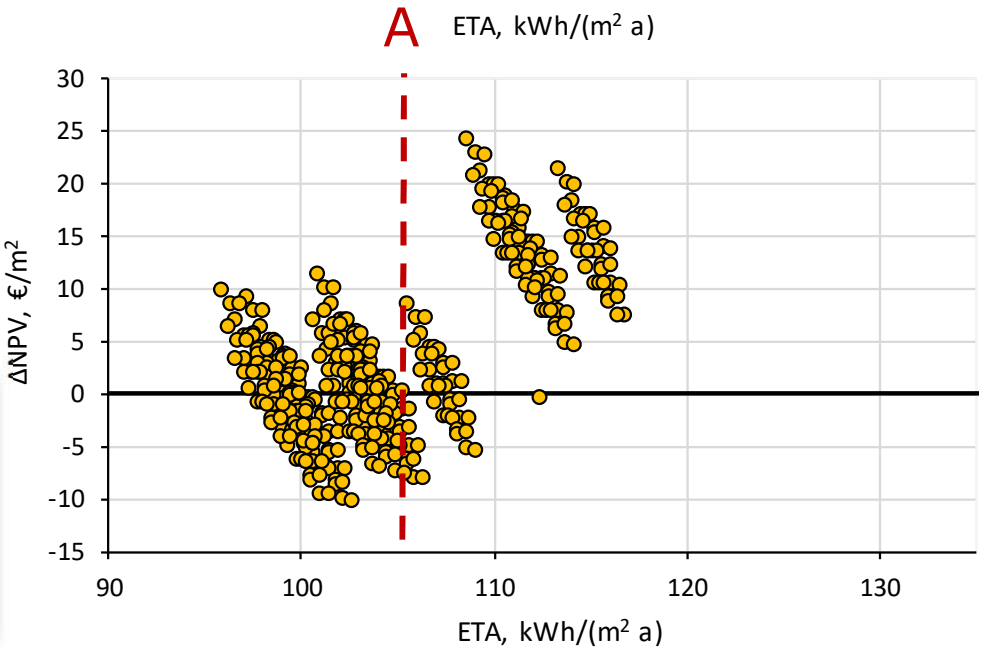
Kuluoptimaalsus

Korterealmu:

- Välispiirete variandid
- Energiamärgise B klass
- + päikesepaneelid
- Energiamärgise A klass







Võimalikud A-klassi lahenduste kombinatsioonid

Korterelamu paketid	Tarindid: Katus U=0.08 W/m²·K	Katus U=0.10 W/m²·K	Katus U=0.12 W/m²·K	Põrand U=0.10 W/m²·K	Põrand U=0.14 W/m²·K	Põrand U=0.18 W/m²·K	Aken U=0.7 W/m²·K	Aken U=0.9 W/m²·K	Aken U=1.1 W/m²·K	Välissein U=0.12 W/m²·K	Välissein U=0.14 W/m²·K	Välissein U=0.16 W/m²·K	q_{50} m³/h·m² @50Pa	Soojusallikas: Kaugküte	Soojusallikas: Gaasikatel	Soojusallikas: Soojuspump[1]	Lokaalne: Päikesekollektor	Lokaalne: PV-paneelid, kW	Δ NPV: ETA	Δ NPV: Δ NPV
Ridaelamu																				
Ver. 1	x			x					x		x		1.5		x			17	78	-9
Ver. 2	x					x		x		x			1.5			ÕV		9	77	-10
Ver. 3	x					x		x				x	1.5			MS		5	75	-39
Korterelamu <3000 m²																				
Ver. 1			x			x		x			x		1.5	x				32	96	-4
Ver. 2		x			x			x			x		1.5	x				32	95	-2
Ver. 3			x			x			x		x		1.5	x				32	99	0
Korterelamu >5000 m²																				
Ver. 1	x					x		x			x		1.5	x				60	98	-7
Ver. 2	x				x			x		x			1.5	x				60	99	-5
Ver. 3			x			x	x					x	1.0	x				60	97	-4

[1]Tabelis kasutatud soojuspumpade lühendid: ÕV- õhk-vesisoojuspump; MS - maasoojuspump

Kuluoptimaalsuse kokkuvõte

- Võrreldes 2011 aastaga on kuluoptimaalsed energiatõhususarvud oluliselt paranenud ja jõudnud kas väga lähedale või läinud isegi mööda liginullenergiatasemest

Hoone	2011 aasta kuluoptimaalne kWh/(m^2 a)	Kuluoptimaalne kWh/(m^2 a)	Liginullenergia nõue kWh/(m^2 a)	Lisamaksumus[1] €/m^2
Väikeelamu 100 m^2	-	**80**	100	40
Väikeelamu 200 m^2	140	**87**	80	49
Ridaelamu	-	**71**	80	26
Korterelamu	145	**103**	100	17
Büroohoone	140	**93**	100	17

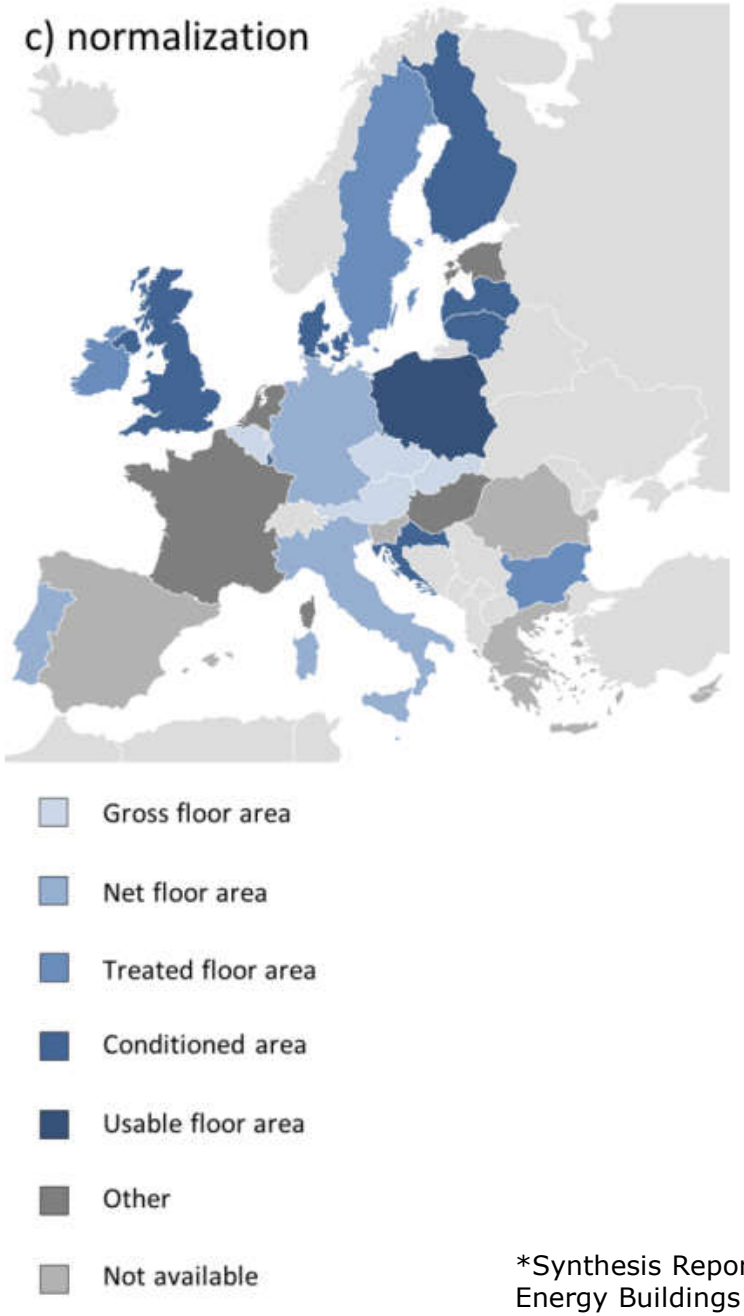
[1]Kuluoptimaalse taseme lisamaksumus brutopinna m^2 kohta ilma käibemaksuta võrreldes referentshoonega.

- Makroökonoomilised arvutused tehti Eestis esmakordselt ja nende tulemused kattusid enamikel juhtudel finantsarvutuse tulemustega
- Oluliselt rekonstrueeritavate hoonete energiatõhususe tase on paranenud ühe energiamärgise klassi võrra
- Oluliselt rekonstrueeritavate väikeelamute, korterelamute ja büroohoonete tulemuste järgi tuleks olulise rekonstrueerimise energiatõhususe miinimumnõue viia klassi võrra allapoole C-klassi

https://www.mkm.ee/sites/default/files/kuluoptimaalsuse_aruanne_20171128_uus.pdf

Liginullenergianõuded meil ja mujal

Energy frames and nZEB



*Synthesis Report on the National Plans for Nearly Zero Energy Buildings (NZEBs)

JRC 2016 data:

nZEB energy performance expressed by Member States

Country	Residential Buildings (kWh/m²/y or Energy Class)		Non-Residential Buildings (kWh/m²/y or Energy Class)	
	New	Existing	New	Existing
Austria	160	200	170	250
Belgium	45 (Brussels region) 30 (Flemish region) 60 (Walloon region)	~54	(95–2.5) *(V/S) (Brussels region) 40 (Flemish region) 60 (Walloon region)	~108
Bulgaria	~30–50	~40–60	~30–50	~40–60
Cyprus	100	100	125	125
Czech Republic	75%–80% PE	75%–80% PE	90% PE	90% PE
Germany	40% PE	55% PE	n/a	n/a
Denmark	20	20	25	25
Estonia	50 (detached house)	n/a n/a n/a n/a	100 (office buildings) 130 (hotels, restaurants) 120 (public buildings) 130 (shopping malls)	n/a n/a n/a n/a
	100 (apartment blocks)	n/a n/a n/a	90 (schools) 100 (day care centres) 270 (hospitals)	n/a n/a n/a
France	40–65	80 n/a	70 (offices without AC) 110 (offices with AC)	60% PE n/a
Croatia	33–41	n/a	n/a	n/a
Hungary	50–72	n/a	60–115	n/a
Ireland	45 (Energy load)	75–150	~60% PE	n/a
Italy	Class A1	Class A1	Class A1	Class A1
Latvia	95	95	95	95
Lithuania	Class A++	Class A++	Class A++	Class A++
Luxemburg	Class AAA	n/a	Class AAA	n/a
Malta	40	n/a	60	n/a
Netherlands	0	n/a	0	n/a
Poland	60–75	n/a	45–70–190	n/a
Romania	93–217	n/a	50–192	n/a
Spain	Class A	n/a	Class A	n/a
Sweden	30–75	n/a	30–105	n/a
Slovenia	45–50	70–90	70	100
Slovakia	32 (apartment buildings) 54 (family houses)	n/a n/a	60–96 (offices) 34 (schools)	n/a n/a
UK	~44	n/a	n/a	n/a

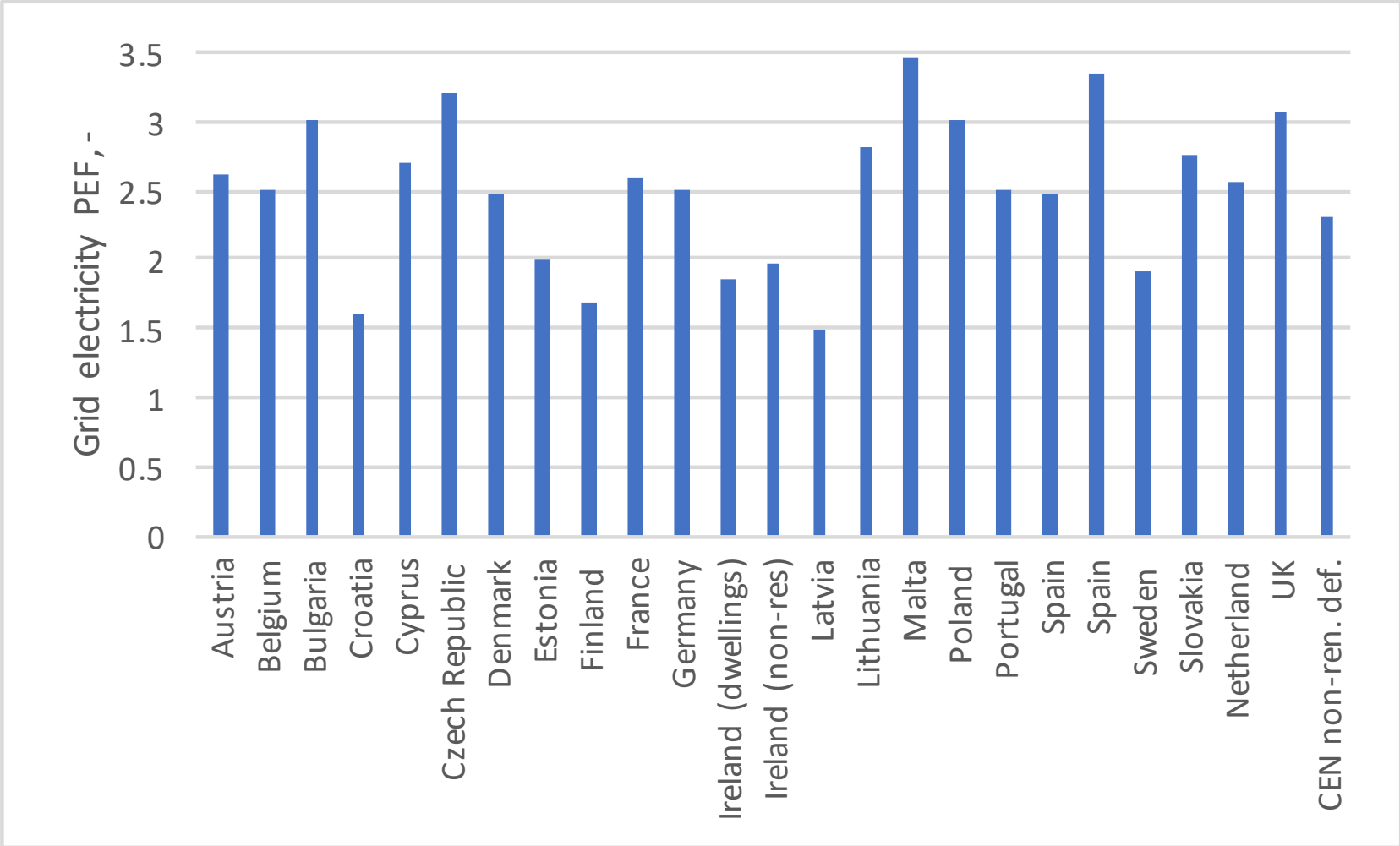
Towards nearly zero energy buildings Denmark

Indicator		Energy frame 2010	Energy frame 2015	Energy frame 2020
Maximum of primary energy to	Residential buildings (houses, hotels, etc.)	52.5 + 1650/A in kWh/m²a	30 + 1000/A in kWh/m²a	**20 kWh/m²a**
	Non-residential buildings (offices, schools, institutions and other buildings)	71.3 + 1650/A in kWh/m²a	41 + 1000/A in kWh/m²a	**25 kWh/m²a**
Primary energy factors	Electricity	2.5	2.5	1.8
	District heating	1.0	0.8	0.6

Weighting factors

- Most MS use primary energy or weighting factors which are more energy policy factors (covering primary energy, CO_2, cost, environmental etc. aspects)

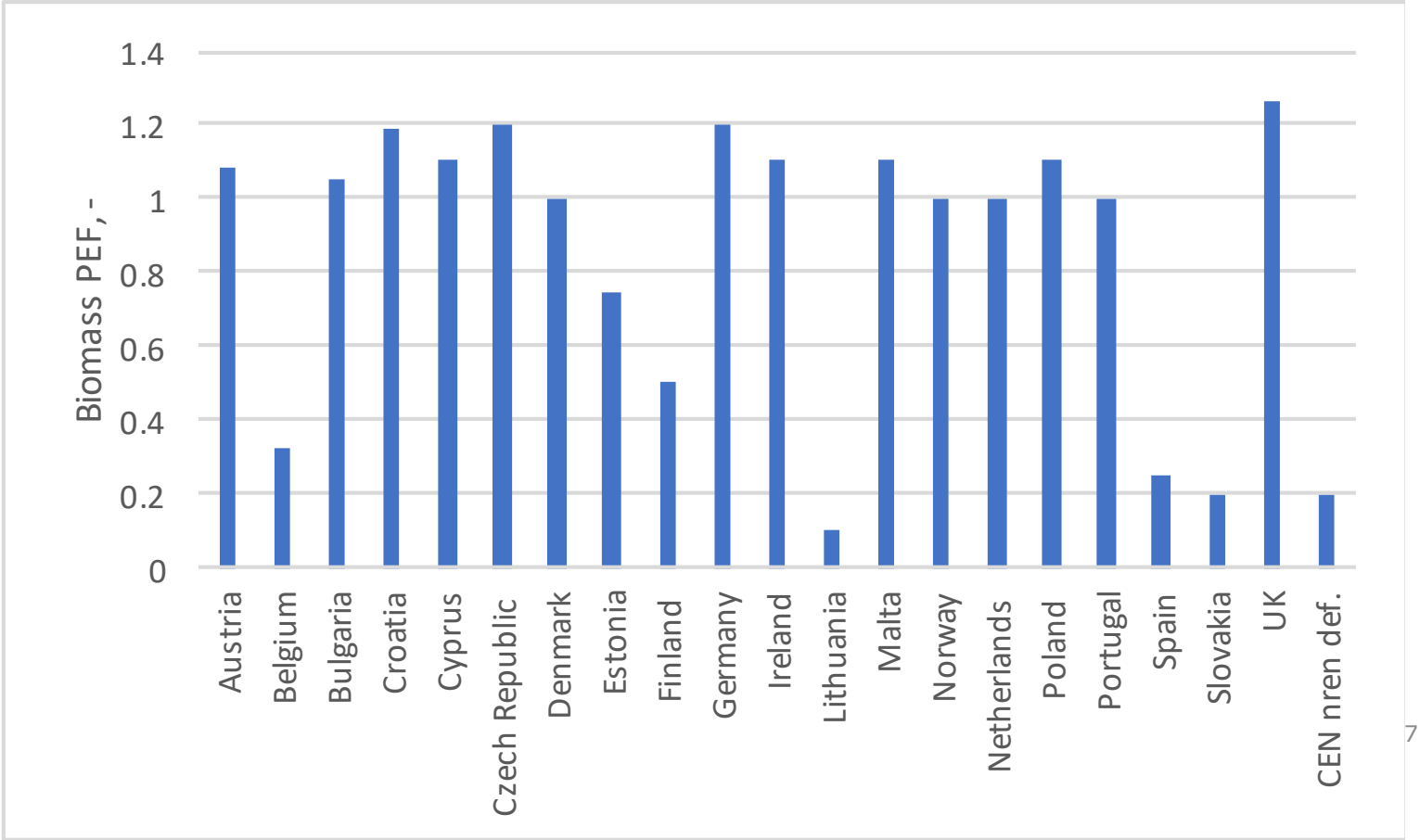
Grid electricity primary energy factors



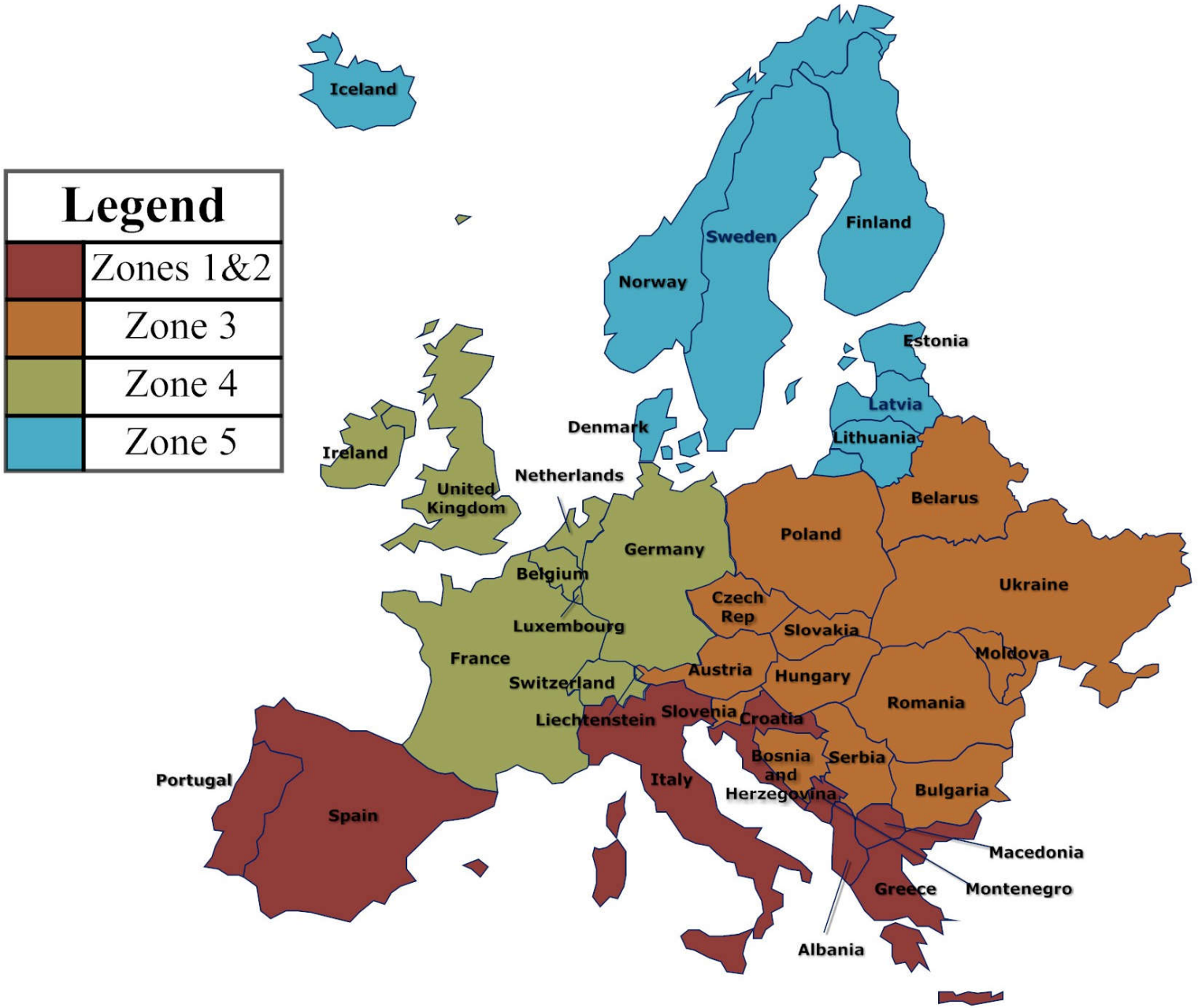
Weighting factors

Biomass primary energy factors

- CEN non-ren default PEF=0.2 means that in the case of biomass boiler there is no need to insulate the building
  - Correct from energetic point of view
  - Conflicts with biofuel cost
  - Conflicts with resource availability



Map of European climatic zones



Euroopa Komisjoni soovitus (EL) 2016/1318

Liginullenergiahoone tasemele vastav energiatõhususarvu väärtus	**Vahemere tsoon** 1. tsoon: Catania (Ateena, Larnaca, Luga, Seville, Palermo)	**Mereline tsoon** 4. tsoon: Pariis (Amsterdam, Berliin, Brüssel, Kopenhaagen, London, Praha)	**Kontinentaalne tsoon** 3. tsoon: Budapest (Bratislava, Ljubljana, Milano, Viin)	**Põhjamaad** 5. tsoon: Stockholm (Helsingi, Tallinn, Riia, Gdansk, Tovarene)
Büroohooned, kWh/(m²·a)				
Primaarenergia netotarbimine	20-30	40-55	40-55	**55-70**
Primaarenergiatarve	80-90	85-100	85-100	85-100
Lokaalne taastuvenergia	60	45	45	30
Väikeelamud, kWh/(m²·a)				
Primaarenergia netotarbimine	0-15	15-30	20-40	**40-65**
Primaarenergiatarve	50-65	50-65	50-70	65-90
Lokaalne taastuvenergia	50	35	30	25

- Kontorihoone piirväärtused ei sisalda seadmete energiatarvet.
- Väikeelamu piirväärtused ei sisalda seadmete ja valgustuse energiatarvet.

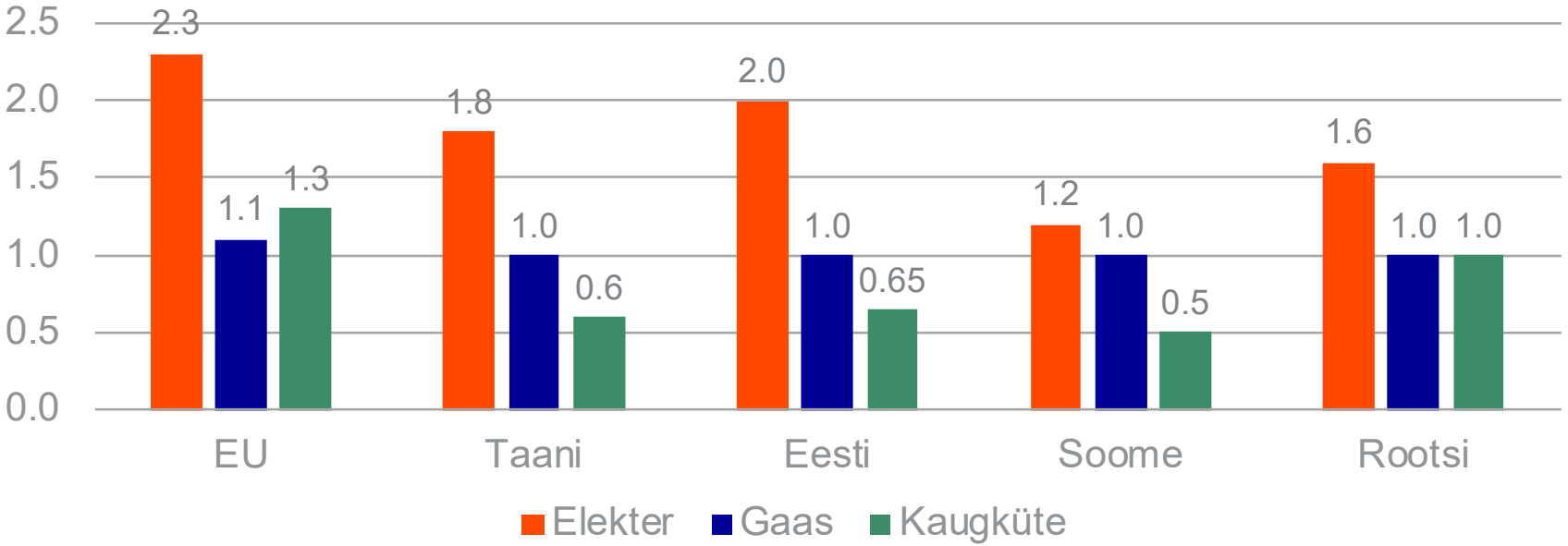
Euroopa Komisjon

Korterelamu liginullenergiahoone nõuded lähiriikides

Riik	Energiatõhususarvu piirväärtus, kWh/(m²·a)	Energiatõhususarvu piirväärtus, ainult KVJ, kWh/(m²·a)
KOM - Põhjamaad	40...65	40…65
Taani	20	20
Eesti	**105**	**47**
Soome	90	56
Rootsi	78	75
Norra	95	66

- KOM – Põhjamaad on Euroopa komisjoni (EL) 2016/1318 soovitus Põhjamaade kliimatsoonis
- Piirväärtus, ainult KVJ (küte, ventilatsioon, jahutus) väljendab energiatõhususarvu ilma seadmete ja valgustuse energiakasutuseta
- KOM, Taani ja Rootsi piirväärtused ei sisalda seadmete ja valgustuse energiakasutust; Rootsi piirväärtus sisaldab erinevalt teistest üldvalgustust
- Eesti piirväärtus suureneb 47 pealt 69-ni kui rakendada EU kaalumistegurite vaikeväärtusi

Energiakandjate kaalumistegurid



- EU kaalumistegurid viitavad standardi ISO 52000-1:2017 vaikeväärtustele
- Norras kaalumistegureid ei rakendata

Energy calculation input data

	EU	Estonia	Finland	Sweden	Norway
Occupant, m^2/person	28.3	28.0	28.0	28.0	78.0
Appliances, W/m^2	3.0	[a]3.0	4.0	4.4	3.0
Lighting, W/m^2	9.0	8.0	9.0	8.0	1.95
Usage time	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00
Ventilation operation hour	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00	0:00-24:00
Lighting usages rate	0.14	0.1	0.1	0.1	0.67
Occupancy usages rate	0.6	0.6	0.6	0.6	0.67
Appliance usages rate	0.6	0.6	0.6	0.6	0.67
Domestic hot water use, kWh/m^2 a	25	30	38	29	29.8
Ventilation rate, l/m^2 s	0.5	0.5	0.5	0.35	0.33
Heating set point, °C	20	21	21	21	21
Generation efficiency, gas boiler, -	0.95	0.95	1.0	0.95	0.86
Generation efficiency, district heating	1.0	1.0	0.97	1.0	0.98
Distribution & emission efficiency, -	0.91	0.97	0.85	0.97	0.97
Circulation pump, $kWh/(m^2$ a)	2.0	0.5	2.0	2.0	2.0

[a] Internal heat gain value which is divided by factor 0.7 in order to obtain the electricity use

*EU - prEN 16798-1:2017 standardized input data

Revised EPBD
Uuendatud direktiiv (EU) 2018/844
avaldatud 19.06.2018

Hoonete energiatõhususe direktiivi uus versioon

Avaldatud 19. juuni 2018.
Üle võtmiseks aega 20 kuud avaldamisest.

Hoonete energiatõhususese nõuete täiendused:

- sisekliima tähtsus;
- elektriautode laadimistaristu või paigaldamise valmidus;
- *smart readiness indicator* – nutikus(valmiduse) näidik;
- tehnosüsteemide ülevaatus ja hoone kontroll- ja automaatikasüsteemide paigaldamise nõuded;
- olemasoleva hoonefondi renoveerimine, pikaajaline renoveerimiskava aastani 2050.

New EPBD items

1. **Renovation strategy and NZEB performance**

2. **Ventilation, indoor air quality and comfort levels to be defined by Member States**

3. **Smart readiness indicator and building automation**

Pikaajaline renoveerimisstrateegia

- Liikmesriigid loovad pikaajalise renoveerimisstrateegia, mis hõlmab kogu hoonefondi.
- Eesmärgiks on olemasolevate hoonete kulutõhus ümberehitus liginullenergiahooneteks.
- Tegevuskava hõlmab soovituslikke vahe-eesmärke 2030, 2040 ja 2050 a.

• Strateegia hõlmab:
+ kulutõhusate lahenduste määratlemist;
+ poliitikaid ja meetmeid, edendamaks renoveerimise terviklahenduste rakendamist;
+ turutõrgete käsitlus.
• Investeeringute mobiliseerimiseks:
+ projektide koondamine;
+ riskide vähendamine erasektorit jaoks.

Long-term renovation strategy

- It is stated that Member States shall establish a long-term strategy facilitating the cost-effective **transformation of existing buildings into nearly-zero energy buildings**
- This includes setting out a roadmap with measures and domestically defined measurable progress indicators, with a view to the long-term 2050 goal of reducing greenhouse gas emissions in the Union by 80-95% compared to 1990
- According to the EC's impact assessment, **3 % renovation rate** would be needed to accomplish the Union's energy efficiency ambitions in a cost-effective manner
- The roadmap shall include indicative milestones for 2030, 2040 and 2050
- The strategy should cover:
  - policies and actions to stimulate cost-effective deep renovations
  - **mobilisation of investments into the renovation**

Indoor Environmental Quality in new EPBD

- Currently there are no binding ventilation and IEQ requirements at EU level
- From a regulatory point of view this remains under the competencies and responsibilities of the EU Member States

In EPBD Annex 1, new requirements are set:

- "The energy needs for space heating, space cooling, domestic hot water, lighting, ventilation and other technical building systems shall be calculated in order **to optimise health, indoor air quality and comfort levels defined by Member States** at national or regional level"

- Mandate to MS to establish minimum ventilation and other IEQ requirements for new buildings and major renovations to implement the directive

Smart Readiness Indicator SRI

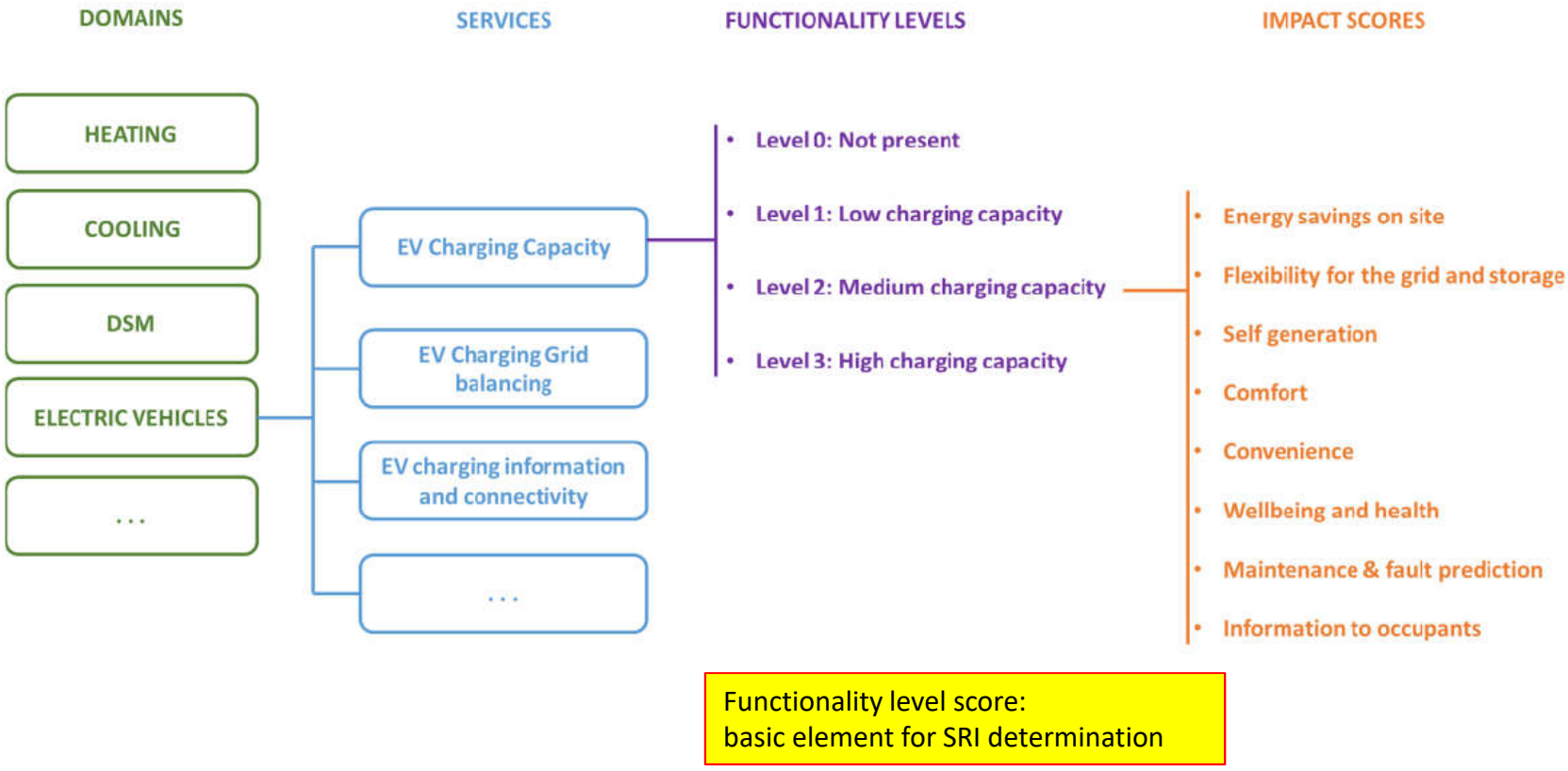
The 2nd EPBD recast introduces a new indicator, the Smart Readiness Indicator (SRI):

"*an assessment of the capabilities of a building or building unit to adapt its operation to the needs of* ***the occupant and the grid*** *and to improve its energy efficiency and overall performance*"

A delegated act will establish an **optional** common EU scheme for rating the smart readiness, that will define SRI and will establish a methodology to calculate it



SRI Calculation Methodology – catalogue of smart ready services



Functionality level score:
basic element for SRI determination

Final report of first technical study published 26 Aug, 2018:
https://smartreadinessindicator.eu/milestones-and-documents

SRI Functionality Levels

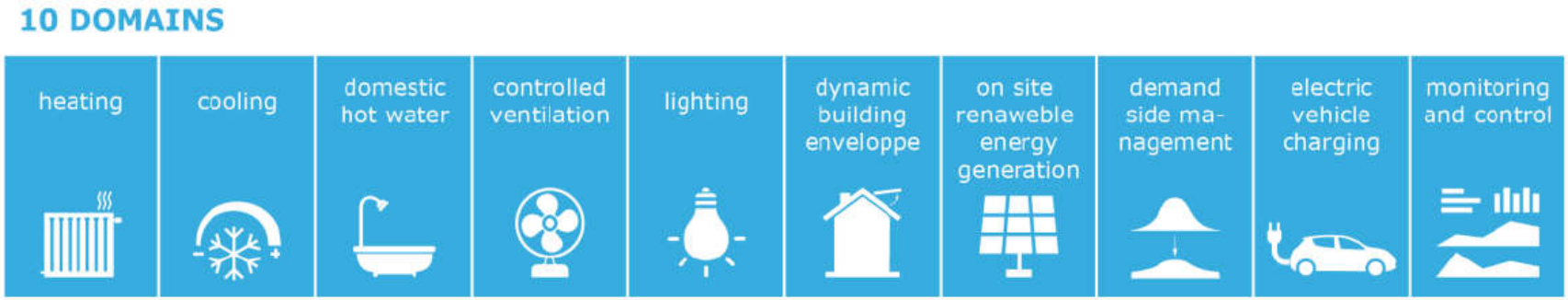
- Functionality levels are ordinal numbers, implying that ranks cannot be compared in between distinct services.
- The number of functionality levels varies from service to service, the maximum level can be as low as 1 or as high as 5.
- A higher functionality level means "smarter" service

Functionality levels for Subservice Heat Emission Control - Heating-1a	
level 0	No automatic control
level 1	Central automatic control (e.g. central thermostat)
level 2	Individual room control (e.g. thermostatic valves, or electronic controller)
level 3	Individual room control with communication between controllers and to BACS
level 4	Individual room control with communication and presence control

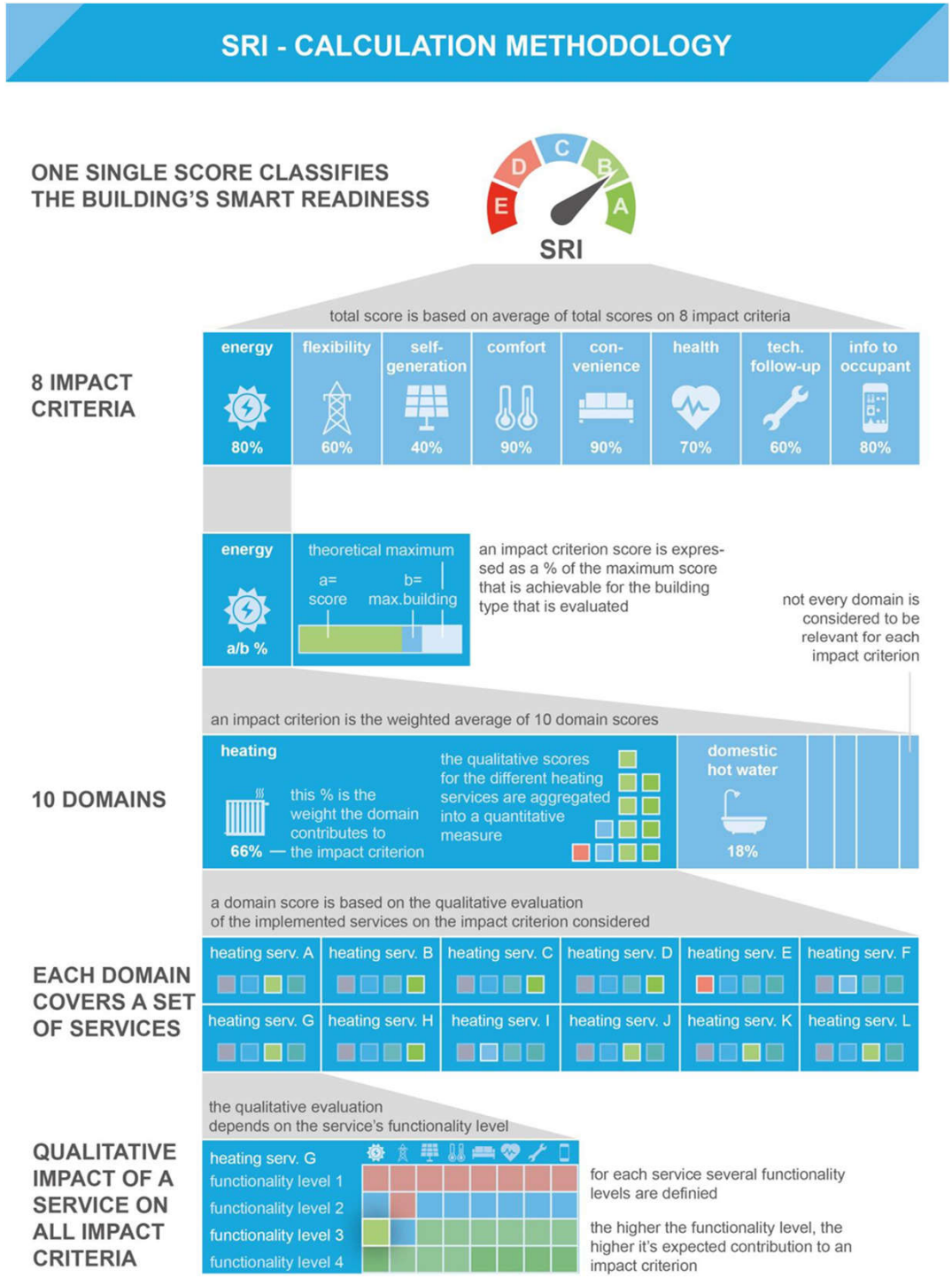
SRI Domains

10 Domains:

- Heating
- Domestic hot water
- Cooling
- Mechanical ventilation
- Lighting
- Dynamic building envelope
- On-site energy generation
- Demand side management
- Electric vehicle charging
- Monitoring and control



Method Overview



Kokkuvõte

- 2030 energia- ja kliimapoliitika eesmärgid annavad energiatõhususe parandamisele hoogu juurde ning koostamisel on riiklik energia- ja kliimakava aastani 2030
- Kõik liikmesriigid on kehtestanud liginullenergianõuded, mis on ilmselgelt erineva ambitsiooniga ning rahvuslike metoodikate tõttu ülimalt keerulised võrrelda
- Liginullenergia "segadust" püütakse lahendada läbi KOM-i ametlike soovituste ning kuluoptimaalsuse printsiibi järgimisega – iga 5 a tagant tuleb teha uued arvutused ja nõudeid vastavalt korrigeerida
- Eesti kuulub sellesse vähemusse, kelle energiatõhususe nõuded on kooskõlas KOM soovitustega
- Hoonete energiatõhususe direktiivi suurim uuendus on endisest oluliselt suuremahulisem renoveerimine ning sellele rahastamise tagamine