

# US DOE launched a common definition for Zero Energy Buildings



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DOE launched ZEB definition which is very similar to REHVA definition and relies on site boundary being exactly the same as REHVA's system boundary. DOE definition provides valuable input to European discussion in exported energy issues and for instance by addressing Renewable Energy Certificates.

Primary energy commonly used in Europe is called Source Energy (Renewable & Non-Renewable) in DOE definition [1] being a major difference in terminology. The system boundary for zero energy accounting follows exactly the REHVA's one [2] and addresses energy need, energy use, and delivered and exported energy accounted on *site boundary*, **Figure 1**. If compared to the REHVA's system boundary, **Figure 2**, one can see that even the same terms have been used – reflecting the same basic understanding by European and US energy experts. Regarding to the European regulators discussion, should lighting and appliances be accounted in energy performance or not, DOE clearly states that all energy used in the building, including lighting, plug loads and even processes, is considered as energy performance of a building, fully supporting REHVA's previous proposal.

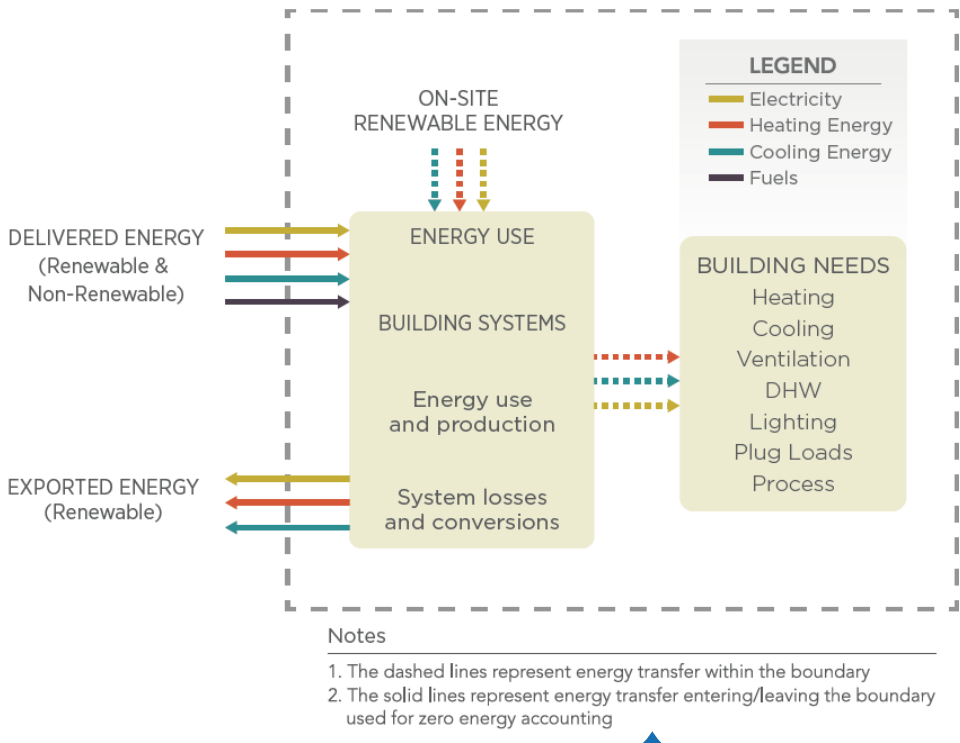
DOE defines Zero Energy Building (ZEB) as “An energy-efficient building where, on a source energy

basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.” Therefore, the definition is based on annual balance of delivered and exported primary energy. This definition equals to REHVA net Zero Energy Building (net ZEB) definition “Non-renewable primary energy of 0 kWh/(m<sup>2</sup> a).” Both DOE and REHVA provide an explanation that ZEB (net ZEB by REHVA) is typically a grid-connected building that is very energy efficient. “The premise is that ZEBs use the electric grid or other energy networks to transfer any surplus of on-site renewable energy to other users.”

The site boundary is defined as a meaningful boundary that is functionally part of the building(s). “For a single building on a single property, the site boundary is typically the property boundary. The site boundary should include the point of utility interface”. Definitions for zero energy campus, portfolio and community would allow to extend the site boundary and to include for instance the site energy centers.

In zero energy campus, portfolio or community definitions a word “building” is just replaced by campus, portfolio or community. For example, Zero Energy Community: “An energy-efficient community where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy.”

DOE definition has no limitations for exported energy and the same primary energy factors are used both for delivered and exported electricity. US primary energy factor for electricity of 3.15 is somewhat higher than European one of 2.3. It is considered that exported on-site renewable electricity displaces electricity that would be required from the grid. “In ZEB accounting, the exported energy is given the same source energy conversion factor as the delivered energy to appropriately credit its displacement of delivered electricity”, that is also a default choice in REHVA definition. The source energy conversion factors utilized are from ASHRAE Standard 105, and they are summarized in **Table 1**.



**Figure 1.** DOE Site Boundary of Energy Transfer for Zero Energy Accounting.

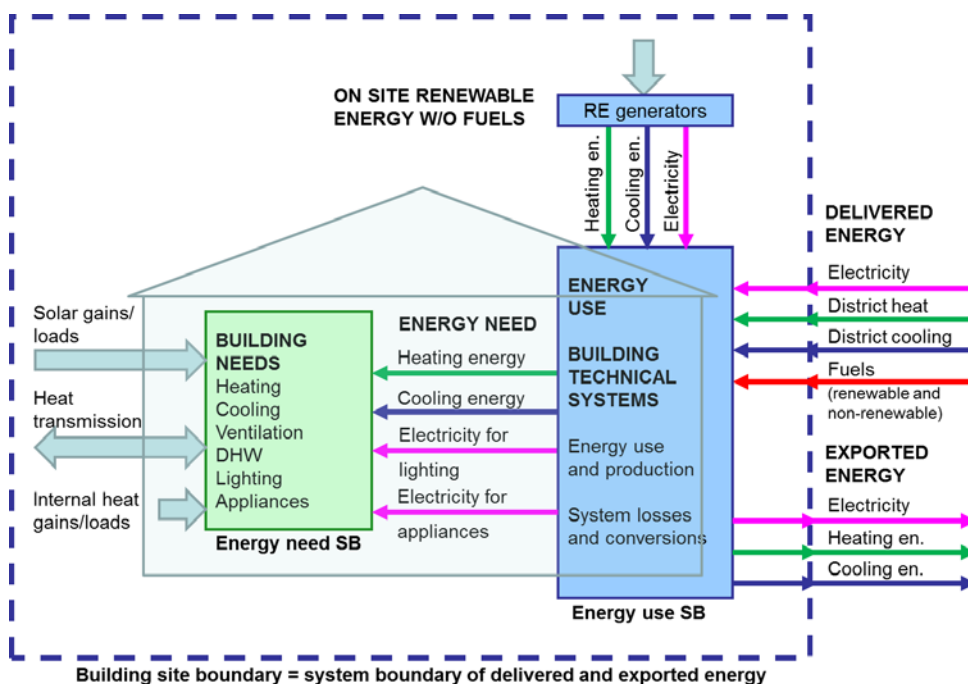
**The situation at CEN and ISO standardisation:**

The current Overarching Standard the prEN ISO 52000-1 (former prEN15603) offers via the Annex A-B approach all required flexibility to follow the REHVA and DOE approach. In Europe it is the wish of the EU-Member States to choose their own default parameters to handle imported, exported and primary energy and building- site and nearby boundary.

It is expected that non-EPB use is not included in the equation, however the standard can also support a ZEB definition where this is included.

The added value of the DOE approach is that clear choices have been made. This DOE statement doesn't imply a federal regulation in the USA but may lead the discussion in the right direction.

The EU Commission will require the use of the EPBD-standards inclusive the annex B as required option in the framework of the Voluntary Certification Scheme for Non-Residential buildings. This is similar to, or perhaps even more regulatory, compared with this DEO initiative which will encourage all US stakeholders to act accordingly.



**Figure 2.** REHVA system boundary from 2013 [2].

**Table 1.** US National Average Source Energy (primary energy) Conversion Factors.

Energy Form	Source Energy Conversion Factor (r)
Imported Electricity	3.15
Exported Renewable Electricity	3.15
Natural Gas	1.09
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.19
Propane & Liquid Propane	1.15
Steam	1.45
Hot Water	1.35
Chilled Water	1.04
Coal or Other	1.05

DOE definition addresses the use of Renewable Energy Certificates (REC) which are tradable instruments that can be used to meet voluntary renewable energy targets. “Once a buyer makes an environmental claim based on a REC, the buyer can no longer sell the REC and the REC is considered permanently “retired”.” The ZEB definition and its variations (Campus, Portfolio, Community) require **on-site renewable energy to be used to fully offset** the actual annual delivered energy. Therefore these definitions **do not allow** renewable electricity purchased through the use of renewable energy certificates (RECs) to be used in the ZEB energy accounting.

High rise buildings in dense urban areas or buildings with high process loads may choose to have off-site

renewable electricity utilizing RECs to help balance the annual delivered energy. Special REC-ZEB definition is provided to allow RECs to be used to supplement, after on-site renewable energy sources have been employed, and balance the annual delivered energy to the building. Renewable Energy Certificate - Zero Energy Building (REC-ZEB) is defined as “An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy plus acquired Renewable Energy Certificates (RECs)”.

REC-ZEB is an interesting approach that can be seen as one possible solution for European “nearby generation”, having so far no common grounds and not yet implemented into regulation by any MS. ■

## References

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