

## Zero Energy Buildings: The Role of Building Envelope & Services

*In this paper, we explore the need to have a clear and measurable definition of Net-Zero Energy Buildings: what it means, why this definition is needed, and how we can progress towards the ZEB goal, **all of this while emphasizing on the role and importance of the building envelope and related building services in achieving the same.***

Despite the excitement over the phrase “zero energy,” we lack a common definition, or even a common understanding, of what it means. *The way the zero energy goals are defined affects the choices designers make to achieve this goal and whether they can claim success.* The ZEB definition can emphasize demand-side or supply strategies and whether fuel switching and conversion accounting are appropriate to meet a ZEB goal. *Four well-documented definitions—net-zero site energy, net-zero source energy, net-zero energy costs, and net-zero energy emissions—are studied; pluses and minuses of each are discussed.* These definitions are then applied to a set of low-energy buildings. This study shows the design impacts of the definition used for ZEB and the large difference between definitions. It also looks at sample utility rate structures and their impact on the zero energy scenarios.

The goal that we have chosen to highlight — “Net Zero” — means that the buildings in question produce as much energy as they consume on an annually averaged basis. This necessarily means that they all have some on-site production, wind, PV, solar-thermal hot water, etc. However, *to keep such projects reasonably cost effective, it’s necessary to focus first on energy efficiency measures. Most important among these is a very efficient building envelope, much more insulation than code requires, and appropriate glazing for passive solar gain. Only after doing all that is it financially worthwhile to start adding on-site renewable generation, capable of meeting the overall annual energy demands of the dwelling.*

**The world of zero energy buildings is also about rethinking the envelope, or outer layer, of the building, which includes the roof, walls, and foundation.** The challenge is to build an envelope that is as airtight and well insulated as possible so that the energy that comes into the building stays within the envelope, and any inclement weather outside has little impact on the comfort inside. The following concepts have been discussed to help formulate our understanding for ZEBs:

*Boundary Definitions & Energy Flows*

*How Definition Influences Design*

*Net Zero Site Energy Building*

*Net Zero Source Energy Building*

*Net Zero Energy Cost Building*

*Net Zero Energy Emissions Building*

*Sample of Current Generation Low-Energy Buildings*

*Grid connection for energy balances*

*Prioritization of Supply-Side technologies to those available*

Then, we further discuss about the various phenomenon and certain materials used in the building envelope and certain building services that can greatly affect the overall performance as a ZEB. We also highlight various software and tools being used by various designers in different climates to achieve the much coveted ZEB goal.

Just to name a few, the key points discussed are:

*Heat & Air movement considerations for designers*

*Water (and vapour) intrusion as a load factor*

*Insulation & Elimination of thermal bridges*

*Principles of “**Passivehaus**” (Passive House) for controlling energy loads*

*A few important exemplary materials & software/tools for designers*

The Paper also cites some important examples.

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