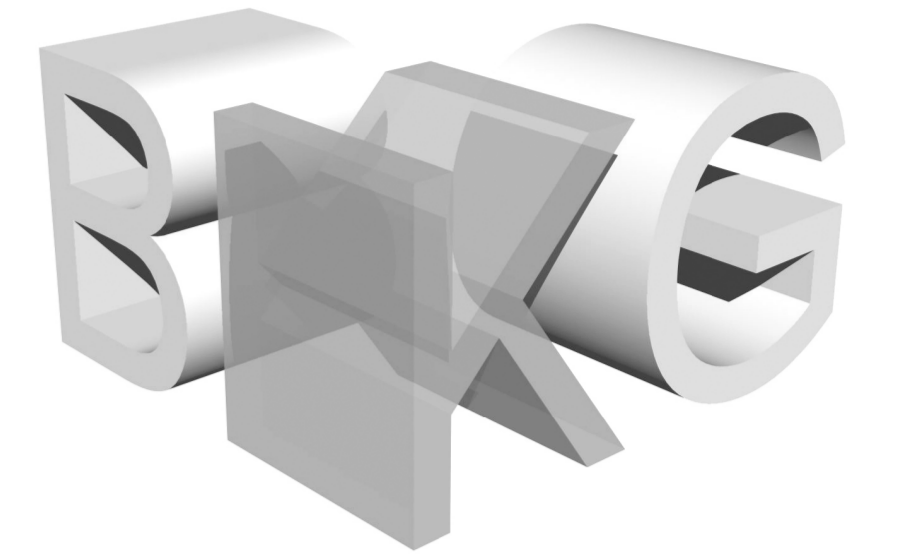


# Konstruktives Gestalten und Baukonstruktion



Master thesis – Marvin Queke

Application of German low-energy building standards to the United States

## Introduction

The international and national fight against global warming is an ongoing process that also includes the building sector. The energy consumption of residential buildings counts up to 40%. Low-energy and high performance building standards are a global approach to lower this consumption. Within this thesis, both high performance building sectors of the U.S. and Germany were compared and opportunities for a mutual applicability were outlined.

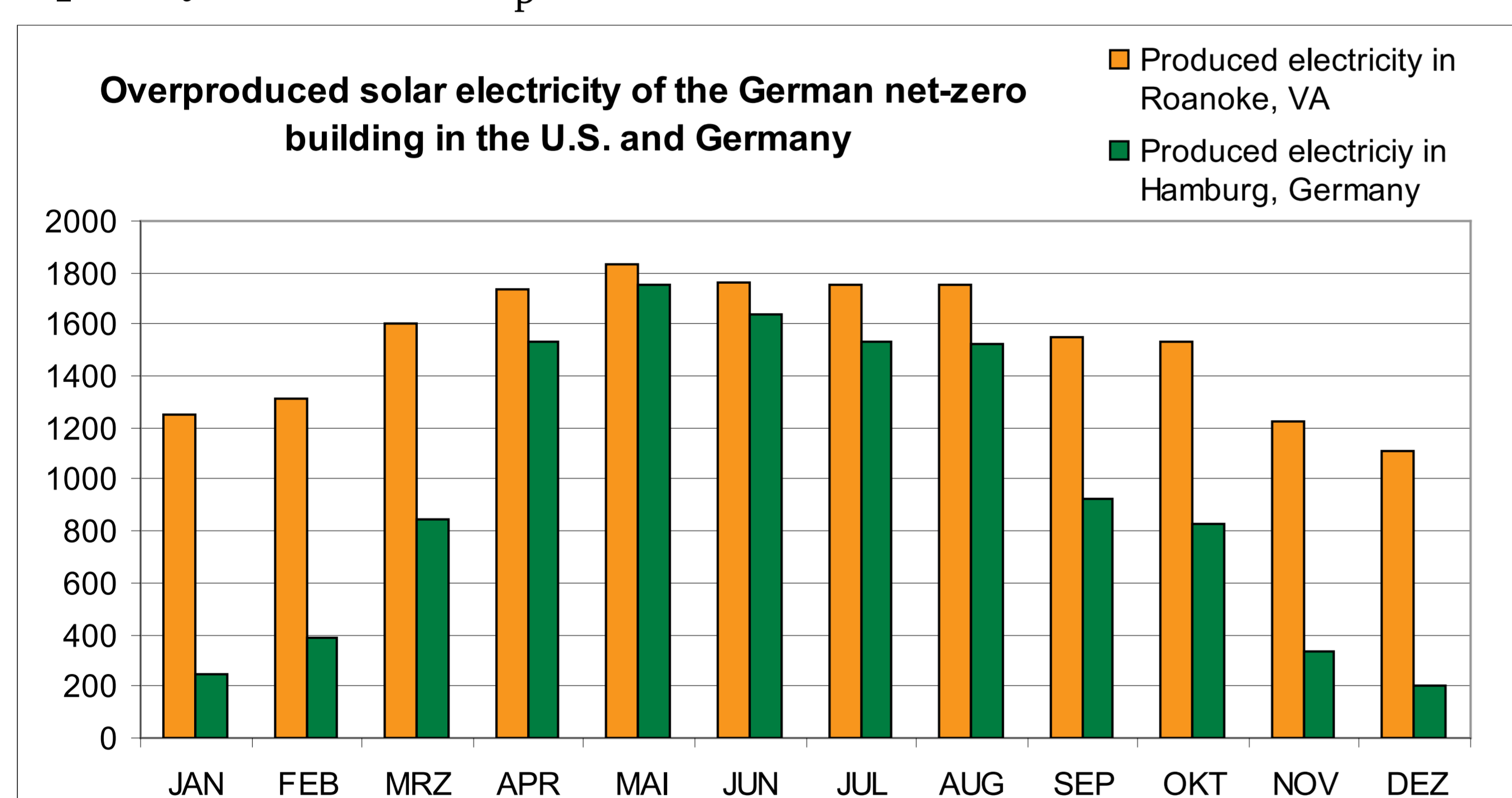


## Residential building characteristics

Building enclosure	
<ul style="list-style-type: none"> <li>Over 90% wood light frame structure.</li> <li>Prescriptive IECC 2015 U-Value<sub>wall</sub>: 0.44 W/m<sup>2</sup>K</li> </ul>	<ul style="list-style-type: none"> <li>73% of residentials are made of masonry.</li> <li>Prescriptive EnEV 2014 U-Value<sub>wall</sub>: 0.28 W/m<sup>2</sup>K</li> </ul>
Building technologies	
<ul style="list-style-type: none"> <li>HVAC with heat pumps because of cooling loads.</li> <li>Air-based duct distribution system.</li> </ul>	<ul style="list-style-type: none"> <li>Cooling is not common.</li> <li>Heat pumps, CHP, wood pellets, solar heat.</li> <li>Water-based distribution.</li> </ul>

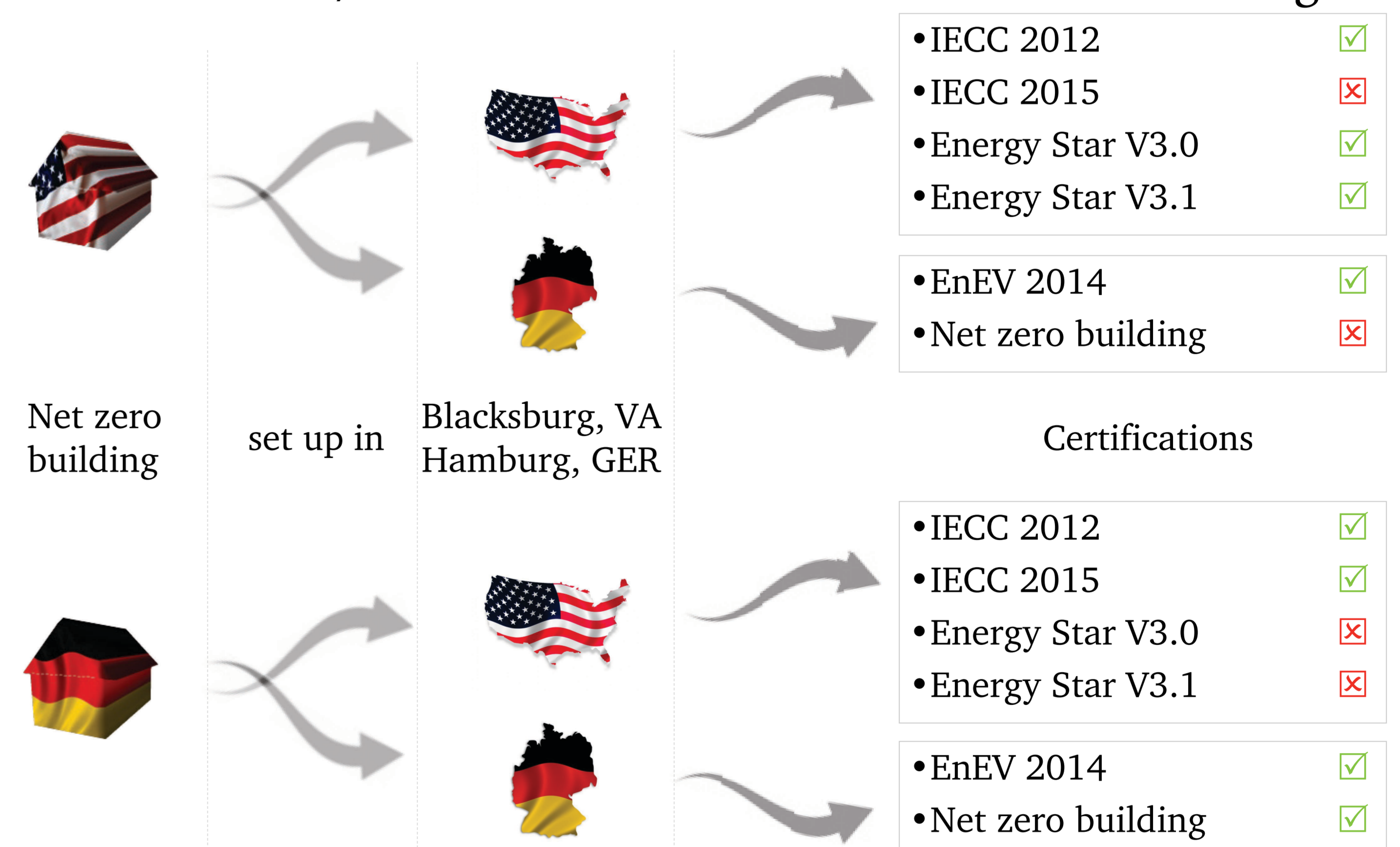
## Climate characteristics

The climate difference between the U.S. and Germany is the most influencing characteristic. While Germany has an almost constant nationwide climate, the U.S. is divided into 7 different climate zones, from very hot to very cold, and from humid to dry. One main climate difference is the global solar radiation. The following figure outlines the differences of overproduced energy through a PV-systems with a capacity of 12.6 kW<sub>p</sub>.



## Simulation

Within 4 software-based calculations it was simulated what happen, if a realized net zero residential building of the U.S. is set up in Germany and vice versa. Therefore, each building was calculated once with the German software “Hottgenroth Energieberater 18599” and the American software “REM/Rate”. Noticeable results are the following:



## Socio economic characteristics

In addition to the climate factors the following socio economic aspects occurred within the comparison:

- The prices for electricity and the building structure itself are cheaper in the U.S. than in Germany. An application of German high performance wall structures would result in longer amortization periods in the U.S.
- 87% of the American households are equipped with a cooling system, which is not common for Germany. This results in different calculation methods and energy demands.

## Summary

- The most critical points that influence the applicability are:
- Germany is highly specialized on their climate zone but not for very hot or very cold climates.
  - A critical amount of water occurs in the standardized wooden wall structure of the American net zero building with German climate conditions (DIN 4108-3).
  - The cooling system is not integrated into the German residential building system.

The applicability is technically possible but, especially, due to climate influences, adjustments have to be made.