

# ENERGY EFFICIENT HOUSES IN THE MIDDLE EASTERN REGION

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**Objective: The Middle East is a region which relies heavily on fossil fuels for energy, the disadvantages of this are well known. Furthermore, even if we were to move towards renewable energy sources there are underlying efficiency issues. Therefore, the objective is to research different methods to improve energy efficiency on a per house basis.**

## DESIGN & CONSTRUCTION

### Problem

What is the most energy efficient way to design the frame of the building

How to insulate the house during construction, so that there is minimal energy loss observed

### Solution

Build double 2x4 walls and insulate any cavity with blown-in cellulose  
Sealing the wall penetrations with spray-on polyurethane foam

### Evaluation

By using the spray-on foam, airtight construction is achieved

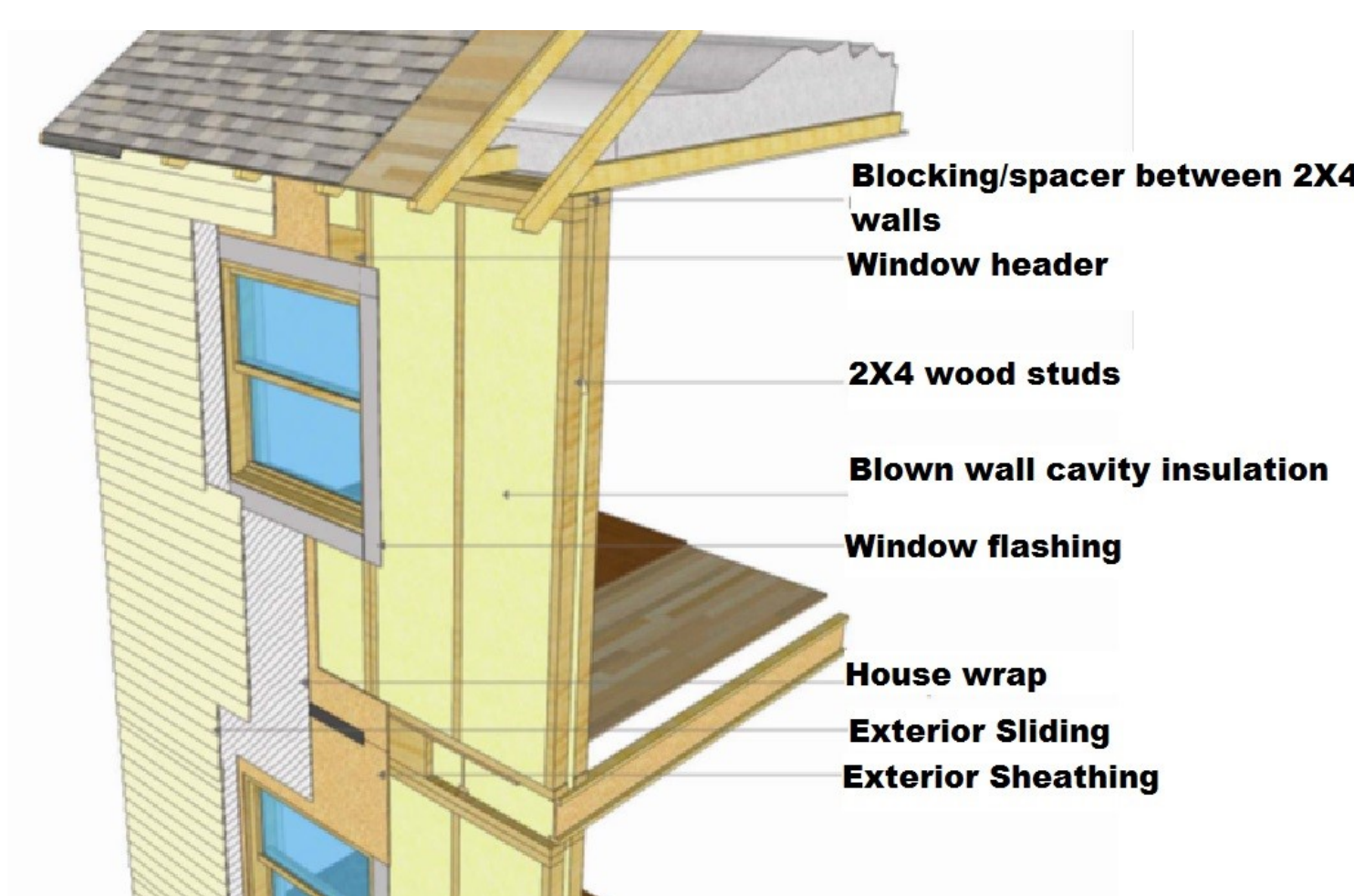


Figure 1: 2x4 double walls frame structure [1]

## COMMUNICATION

### Problem

Lack of communication between suppliers and consumers

### Solution

Implementation of devices called smart meters



Figure 2: Conventional meter on the left and a smart meter on the right [2]

	Smart Meter	Conventional Meter
Record energy consumed	Yes	Yes
Time based pricing	Yes	No
Loss of power and restoration notification	Yes	No
Tamper and energy theft detection	Yes	No
Communication with other intelligent devices	Yes	No

Table 1: Comparison between smart meter and conventional meter [2]

### Evaluation

Table 1 shows that smart meters have more benefits than conventional meters and would help in improving energy efficiency if implemented

## CYBER SECURITY

### Problem

The information across the communication network is sensitive to attacks and could be intentionally manipulated

### Solution

Authenticate the parties in a network

Implement methods of encryption

Run periodically vulnerability scan

### Evaluation

Authentication prevents attackers from accessing the network

Encryption stops attackers from understanding stolen messages

Vulnerability tests make sure that no Trojan viruses exist [3]

## ELECTRIC ENERGY STORAGE

### Problem

Future implementation of smart meters will enable power companies vary the price of electricity several times per day

### Solution

Use an on-site array of batteries to store low-cost energy for use during the peak hours

This has increased electricity savings on average by 10- 15% [4]

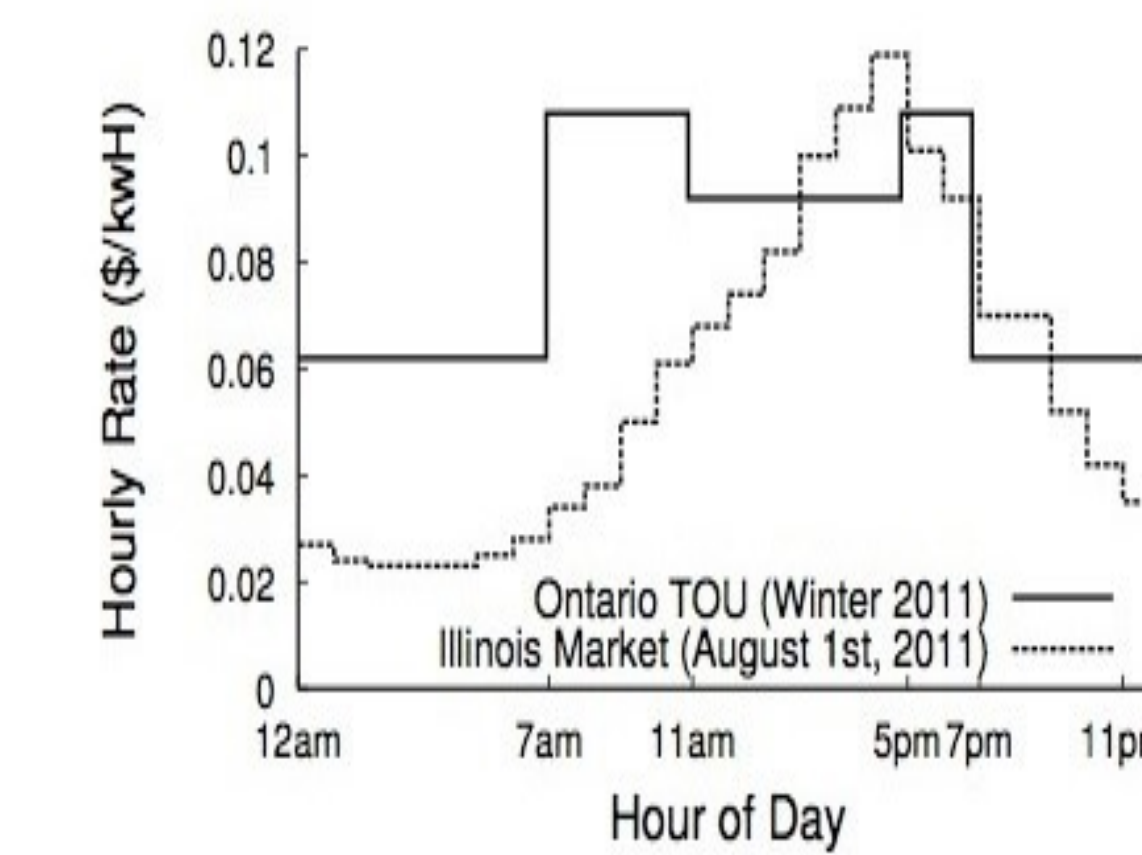


Figure 3: Hourly market-based rate plans in Ontario and Illinois, respectively. [4]

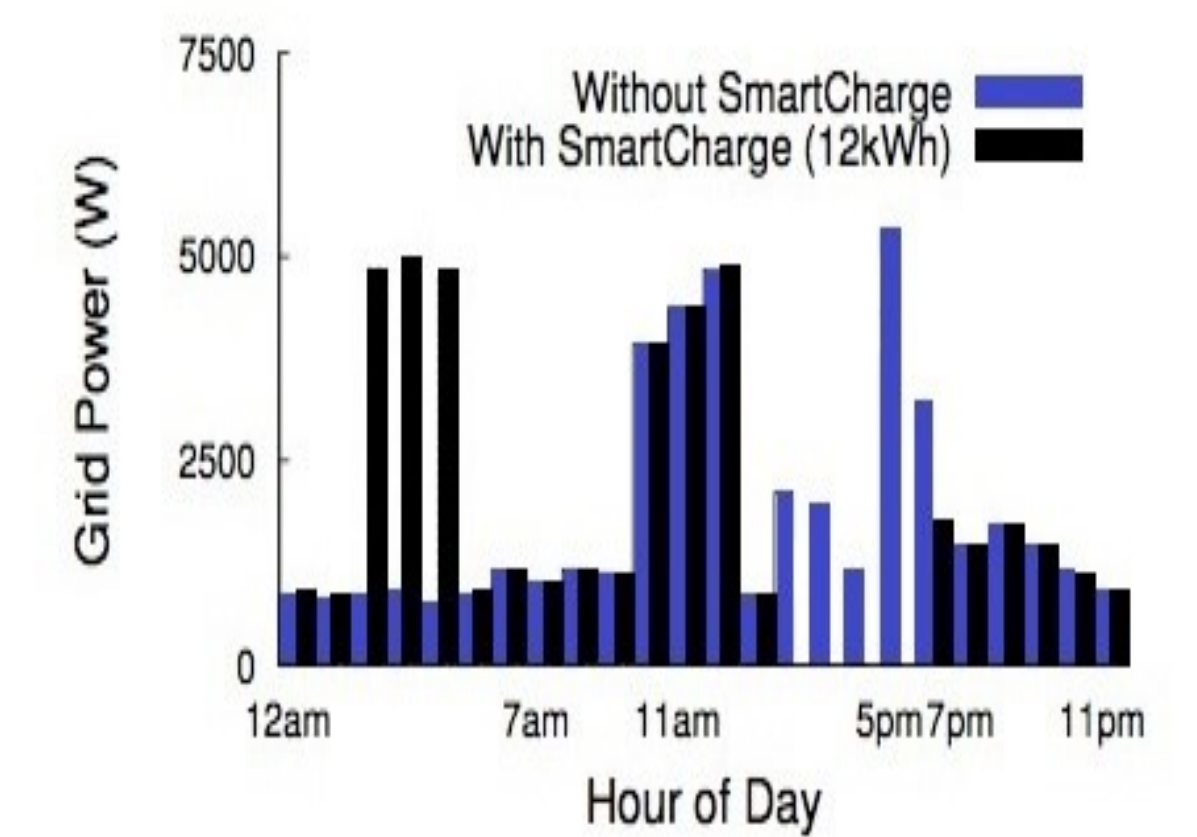


Figure 4: Experiment with and without SmartCharge in Illinois [4]

### Evaluation

Today, the price of setting up and maintaining the battery is greater than the electricity savings. But, we do expect that battery advancements and higher electricity prices in the future will make the return on investment positive.

## CONCLUSION

We have conducted research on several methods to design an energy efficient and secure house in the Middle East

On average, we find that while we did save substantial amounts of energy the cost of implementing these methods are too expensive

However, what makes this project so promising is that we are solving tomorrows problems today

## REFERENCES

[1]R. A. Aldrich, L. Arena, and W. Zoeller, "Practical Residential Wall Systems: R-30 and Beyond."

[2]Advance Metering Infrastructure, white paper, NETL, Feb. 2008

[3]K. Islam, S. Weiming, and W. Xianbin, "Security and privacy considerations for Wireless Sensor Networks in smart home environments," in *Computer Supported Cooperative Work in Design (CSCWD), 2012 IEEE 16th International Conference on*, 2012, pp. 626-633.

[4]A. Mishra, D. Irwin, P. Shenoy, J. Kurose, and T. Zhu, "SmartCharge: cutting the electricity bill in smart homes with energy storage," in *Proceedings of the 3rd International Conference on Future Energy Systems: Where Energy, Computing and Communication Meet*, 2012, p. 29.