Beneficial Electrification: using AMI meter data to reduce electric rates while reducing emissions
Sagewell, Inc

A 5% increase in off-peak sales can double a utility's income. With Sagewell's assistance, public power utilities can grow their revenues and margins, reduce electric rates, reduce costs, and lower carbon emissions all at the same time. When residential electric customers switch home heating from fossil fuels such as natural gas, propane or heating oil to high efficiency electric heat pumps, or from gasoline-powered vehicles to electric vehicles, electric utilities are able to grow their business significantly.

In a recent study for a municipal utility, Sagwell's analysis highlighted that even small increases in off-peak sales could lead to significant increases in income - and allow the utility to pass the gains to customers in the form of lower rates. Because utilities have large fixed costs, but each individual kWh costs very little to produce, the margins on additional kWh sales are very high. When consumed primarily off-peak, utilities are able to improve load factor and delay generation or transmission investments.

The table below shows how even small increases in off-peak sales can have disproportionate increases in income. A 5% increase in off-peak sales can double earnings,10% triple them and 25% increase can increase income by 500%

		--------- PERCENTAGE GROWTH IN SALES ----------		
	Current year	**5%**	**10%**	**25%**
Wholesale cost ($/kWh)	0.06	0.04	0.04	0.04
Retail rate ($/kWh)	0.12	0.12	0.12	0.12
Margin ($/kWh)	0.06	0.08	0.08	0.08
kWh annual sales	130,000,000			
Incremental growth		6,500,000	13,000,000	32,500,000
Contribution margin	$ 7,800,000			
Incremental contribution margin	0	$ 520,000	$ 1,040,000	$ 2,600,000
Total contribution margin	$ 7,800,000	$ 8,320,000	$ 8,840,000	$ 10,400,000
Annnual operating cost	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 7,200,000
Income / "PILOT"	**$ 600,000**	**1,120,000**	**1,640,000**	**3,200,000**
Increase in income		**187%**	**273%**	**533%**
Rate reduction ($/kWh)		0.004	0.007	0.016
Rate reduction percentage		**3.2%**	**6.1%**	**13.3%**

Figure 1 growth potential from an example utility

Given the high operating leverage of off-peak sales, there are two technologies in particular that utilities can encourage their residential customers to adopt: electric vehicles and air source heat

pumps. By fuel switching away from less efficient, higher carbon fuels to electricity, utilities are able to capture a greater share of the total energy consumed in their community, while also reducing carbon emissions and their customer's energy bills.

However, not all technologies are equally valuable to utilities. The value of particular technologies varies based on weather, customer habits, utility costs of supply and capacity, and residential electric rates. A recent analysis for ElectriCities of North Carolina found that, depending on the region of the state, an electric vehicle could double the income from a typical home. However, in many cases, achieving that requires the implementation of EV peak load shifting program (such as Sagewell's award-winning *Bring Your Own Charger®* (BYOC) program that does not require any hardware, such as smart chargers).

Sagewell is able to analyze the economic value of the growth opportunities by using its SageSight[SM] AMI meter data analytics software that can quickly analyze the utility customer base to identify which customers are contributing towards fixed costs and which customers are losing money to the utility. It can also find electric vehicles in the territory using the EVFinder[SM] algorithm and find out if EVs are creating distribution network overload conditions.

The Sagesight[SM] system can also identify the best target customers for programs and help find the customers who can benefit the most from electrification.

When considering home heating, the type of system a utility promotes is very important. Based on analysis for a cold-climate utility, we found that split heat pump systems (single-head or multi-head) were often not used for heating. This resulted in utility funds subsidising installations that neither reduced carbon emissions nor increased kWh sales. However, the analysis did indicate that central ducted heat pump systems were used significantly for heating. Figure 3

below shows the average load shape of single family homes compared to homes with different types of heat pump installations. Central ducted heat pumps increased energy sales between 3,000 and 12,000 kWh annually depending on the size of the home while reducing the carbon emissions by 30% to 50% depending on the fossil fuel being replaced. The analysis also indicated that propane heated homes in the midwest could save as much as $1,000 a home per year.

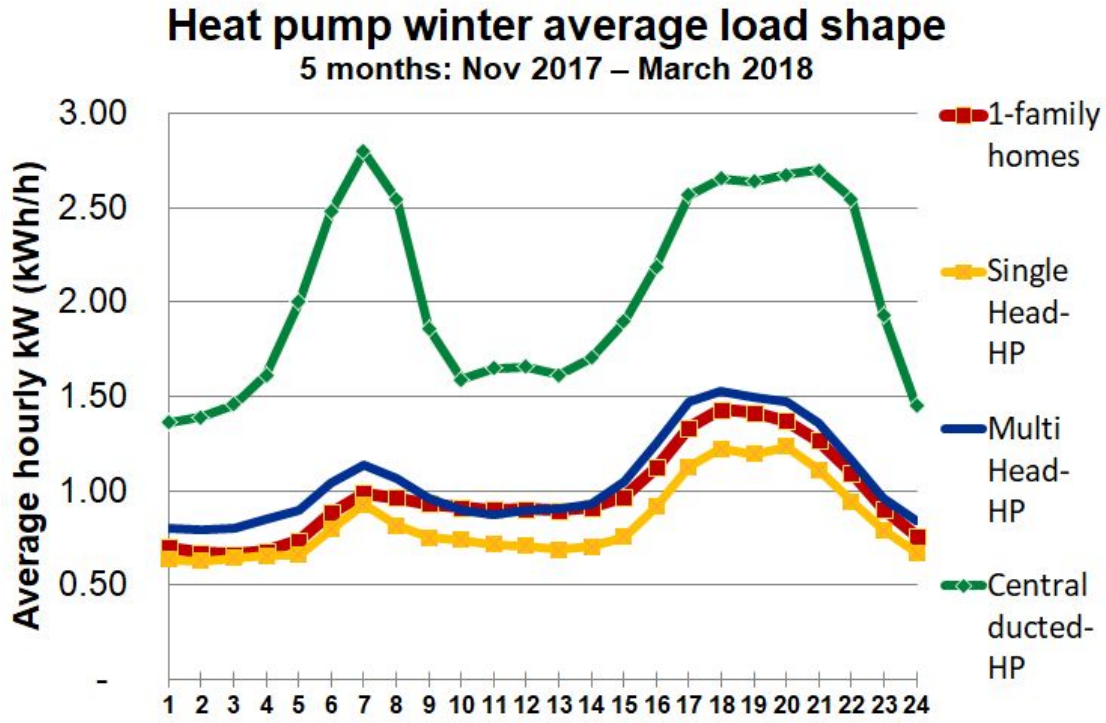

Figure 3 heat pump types and impact on heating load

Given the beneficial economic and environmental impacts of electrification, it is increasingly clear that utilities can deliver significant benefits to their customers by investing in capturing this growth. However, maximizing growth will require different approaches than in the past. For example, Sagewell's analysis shows that rebates and informational campaigns do not increase adoption in a meaningful way. If utilities have analyzed the economic value of EVs or heat pumps, they are able to create programs that increase adoption without spending more on customer fuel conversions than they are worth. Our experience demonstrates that the key to increasing adoption is actively marketing specific EVs and heat pumps to customers to whom they are well suited. For example, Sagewell client Braintree Electric Light Department (BELD) saw EV adoption increase 500% in 2.5 years by actively marketing EVs. Figure 4 compares BELD EV adoption per capita compared to similar towns in the area.

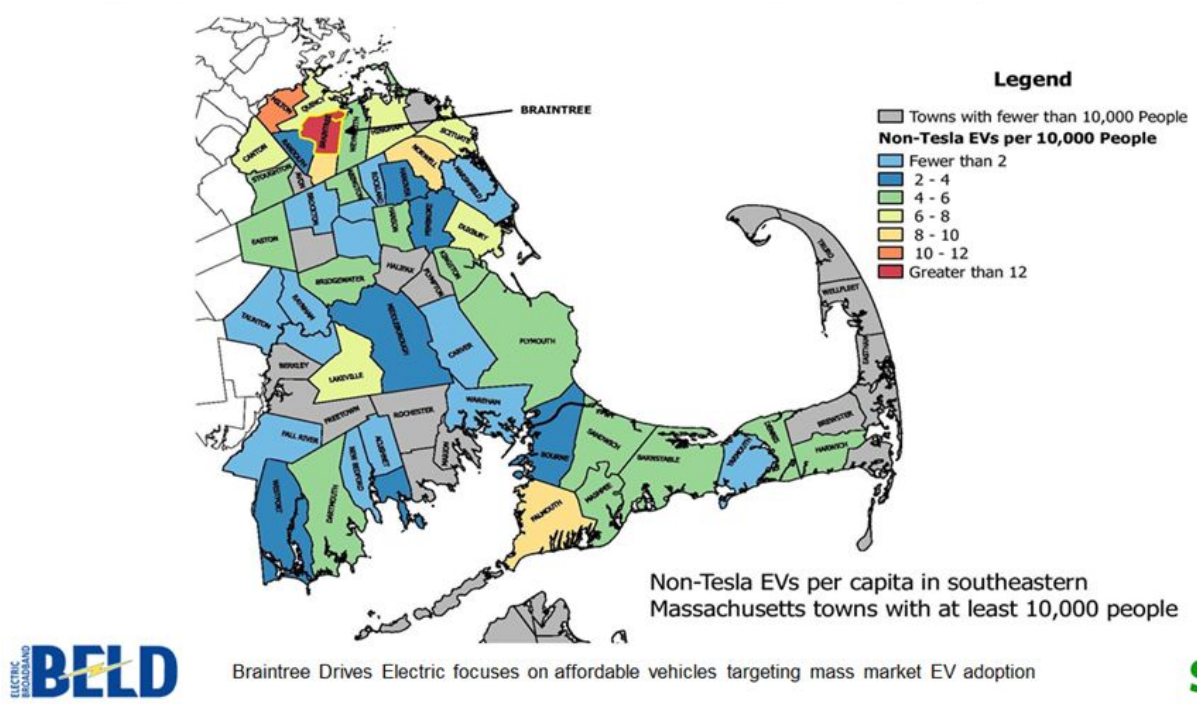

Figure 4 BELD EVs per capita due to marketing program

Beneficial Electrification is the best way for utilities to turn the tide of declining load growth, reduce carbon emissions and save their customers on their energy bills. Driving electric technology adoption requires

1) knowing which technologies to promote,
2) how much they are worth, and

who are the best customers for the products that exist on the market today. Sagewell has helped our clients better understand all three aspects of this challenge, and to take active steps towards a better future.