



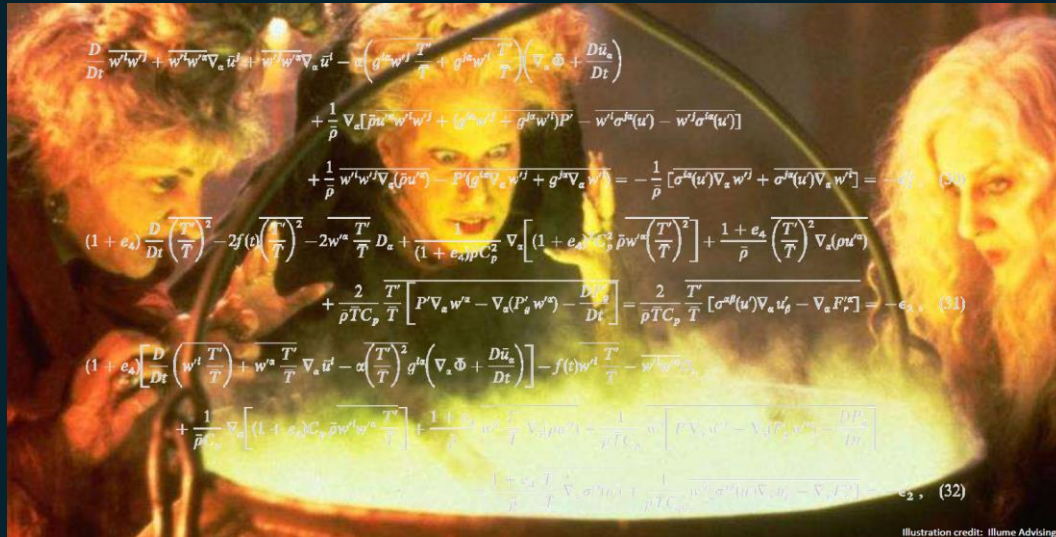
# Evolving Evaluation: No Savings Left Behind

Midwest Energy Solutions Conference

February 18, 2021

# Traditional evaluation is HARD...

## MYSTERIOUS...



$$\begin{aligned} & \frac{D}{Dt} \frac{w^i w^j}{w^i w^j + \overline{w^i w^j} \nabla_a \bar{u}^i + \overline{w^j w^i} \nabla_a \bar{u}^j} - \left( \frac{D^2 \bar{u}^i}{Dt^2} + \frac{D^2 \bar{u}^j}{Dt^2} \right) \left( \nabla_a \bar{u}^i + \frac{D \bar{u}^i}{Dt} \right) \\ & + \frac{1}{\rho} \nabla_a [\bar{p} u^a w^i w^j + (\bar{p} u^i w^j + \bar{p} u^j w^i) \bar{p}^i - w^i \sigma^{ia}(u^j) - w^j \sigma^{ja}(u^i)] \\ & + \frac{1}{\rho} \overline{w^i w^j \nabla_a (\bar{p} u^a)} - \bar{p}^i (\bar{g}^{ia} \nabla_a \bar{u}^j + \bar{g}^{ja} \nabla_a \bar{u}^i) = -\frac{1}{\rho} [\sigma^{ia}(u^j) \nabla_a \bar{u}^j + \sigma^{ja}(u^i) \nabla_a \bar{u}^i] = -\bar{e}_2^i, \quad (30) \\ (1 + e_4) \frac{D}{Dt} \left( \frac{T^*}{T} \right) - 2f(t) \left( \frac{T^*}{T} \right) - 2w^a \frac{T^*}{T} D_a + \frac{1}{(1 + e_4) \rho C_p} \nabla_a \left[ (1 + e_4) \bar{p} w^a \left( \frac{T^*}{T} \right) \right] + \frac{1 + e_4}{\rho} \left( \frac{T^*}{T} \right)^2 \nabla_a (\rho u^a) \\ & + \frac{2}{\rho T C_p} \frac{T^*}{T} \left[ P \nabla_a w^a - \nabla_a (P^i w^a) - \frac{D P^i}{Dt} \right] = \frac{2}{\rho T C_p} \frac{T^*}{T} [\sigma^{ia}(u^j) \nabla_a \bar{u}^j - \nabla_a \bar{P}^i] = -\bar{e}_3, \quad (31) \\ (1 + e_4) \left[ \frac{D}{Dt} \left( \frac{w^i T^*}{T} \right) + w^a \frac{T^*}{T} \nabla_a \bar{u}^i - \alpha \left( \frac{T^*}{T} \right)^2 \nabla_a \left( \nabla_a \bar{u}^i + \frac{D \bar{u}^i}{Dt} \right) \right] - f(t) w^i \frac{T^*}{T} - \overline{w^i w^a \nabla_a \bar{u}^i} \\ & + \frac{1}{\rho C_p} \nabla_a \left[ (1 + e_4) \bar{p} w^a \left( \frac{T^*}{T} \right) \right] + \frac{1 + e_4}{\rho} \overline{w^i w^a \nabla_a (\bar{p} u^i)} - \frac{1}{\rho T C_p} \left[ P \nabla_a \bar{u}^i - \nabla_a (P^i w^a) - \frac{D P^i}{Dt} \right] \\ & = \frac{1 + e_4}{\rho} \frac{T^*}{T} \nabla_a \sigma^{ia}(u^j) + \frac{1}{\rho T C_p} \nabla_a [\sigma^{ia}(u^j) \nabla_a \bar{u}^j - \nabla_a \bar{P}^i] = -\bar{e}_2^i, \quad (32) \end{aligned}$$

Illustration credit: Illumine Advising



- Signal/noise
- Confounding
- Baseline?
- Attribution?

## ...and SLOW



# Deemed savings...

...Fast and convenient



...Backed by the faith  
of the Technical  
Reference Manual



# What's new?



## New challenges

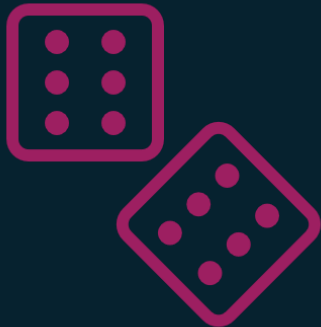
### Mountains of AMI\* and IoT\*\* data

- more signal, less noise
- can measure demand response
- empirical savings baked into program tracking

Data ownership and accessibility

Lack of pre-IoT information

IoT savings fragility?



### Randomization to the rescue

- e.g. home energy reports, thermostat tuning

RCTs\*\*\* forever?

Measure life?





# The institutionalization of deemed savings





# What is the value of deemed savings outside the EE industry?



Do Energy Efficiency Investments Deliver? Evidence from the Weatherization Assistance Program

Meredith Fowlie, Michael Greenstone, Catherine Wolfram

NBER Working Paper No. 21331

Issued in July 2015

NBER Program(s): EEE

**THE WALL STREET JOURNAL** ...because they induce ...ief is primarily ...in experimental ...more than 30,000 ...households. The findings suggest that the upfront investment costs are about twice the actual energy ...savings. Further, the model ...ual savings. While this might be ...ncreases as a result of greater ...r temperatures at weatherized ...energy efficiency investments, the costs ...energy outweigh the benefits; the average rate of return is approximately -9.5% annually.

**The New York Times**



# Can we have both? Yes!

