



DEPARTMENT OF  
ENGINEERING  
SCIENCE



# But why?

## The need for a causal understanding of changes in energy use

ECEEE Summer Study 2024  
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[edol.uk/eceee](http://edol.uk/eceee)

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EUROPEAN COUNCIL  
FOR AN ENERGY EFFICIENT  
ECONOMY

30 YEARS SINCE 1993



SUSTAINABLE, SAFE  
& SECURE THROUGH  
**DEMAND  
REDUCTION**

eceee 2024 Summer Study  
on energy efficiency

Center Parcs Lac d'Ailette  
Hauts-de-France • 10–15 June

#eceee2024

by:



Engineering and  
Physical Sciences  
Research Council

**Why** are you here?



# Why not?



Energy Demand  
Observatory and  
Laboratory

## Establishing causality is difficult

1. Data

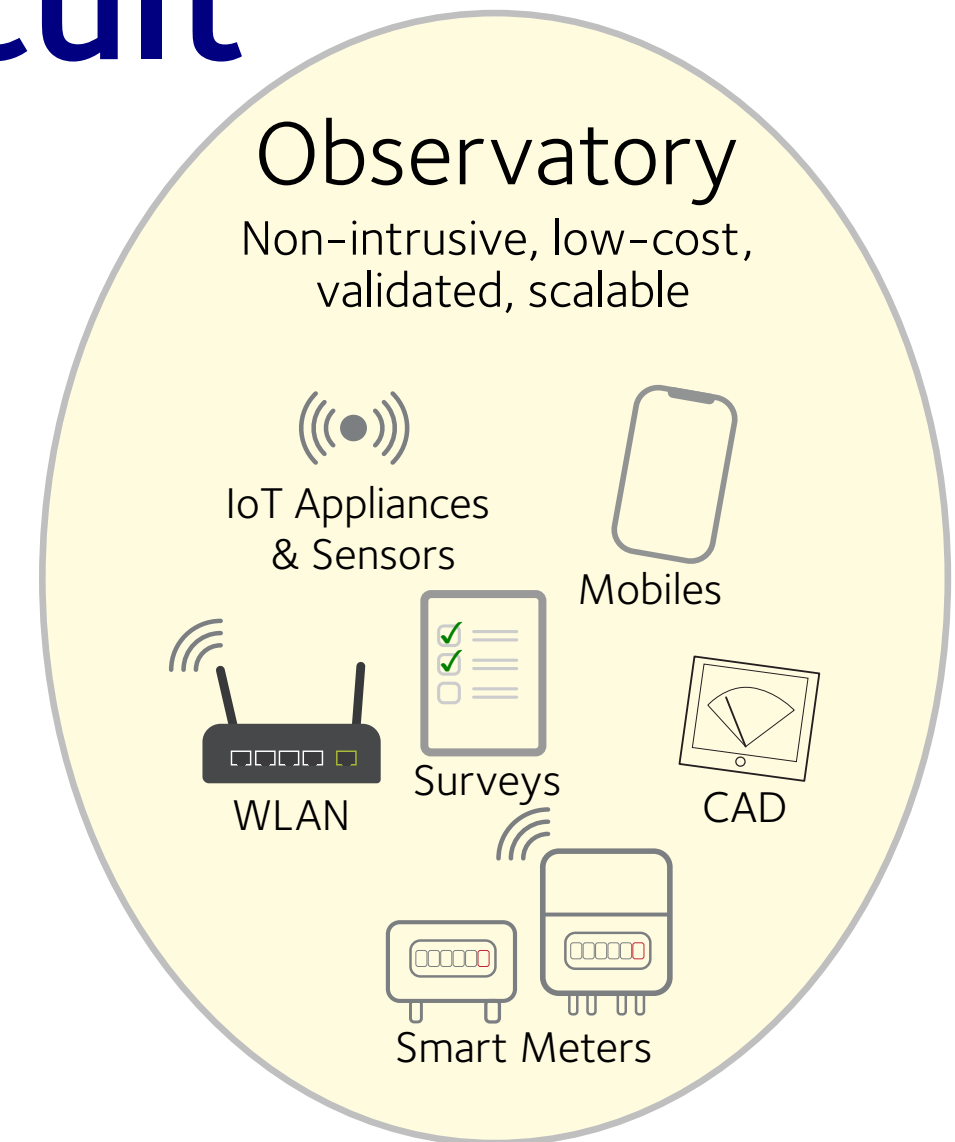
Smart meter + X

2. Scale

$n=2000^+$ ,  $t=5\text{yr}^+$

3. Method

?



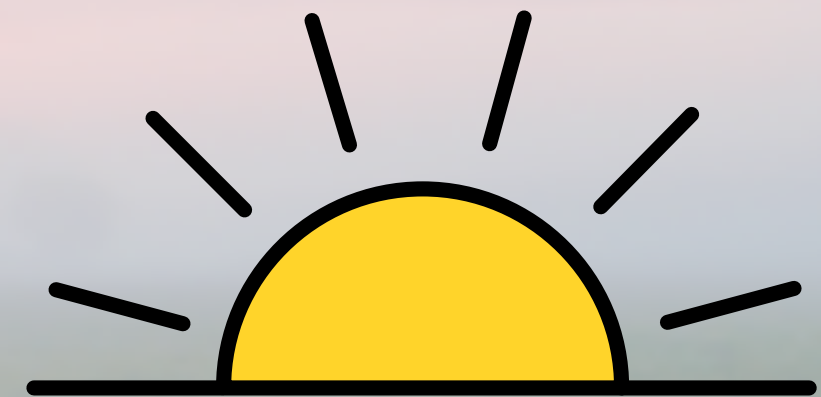


Judea Pearl

Cockerills **cause** the sun to rise



$P(\text{Sun} \mid \text{Crow})$



$P(\text{Sun} \mid \text{do not (Crow)})$

The sun **causes** the cockerill to crow



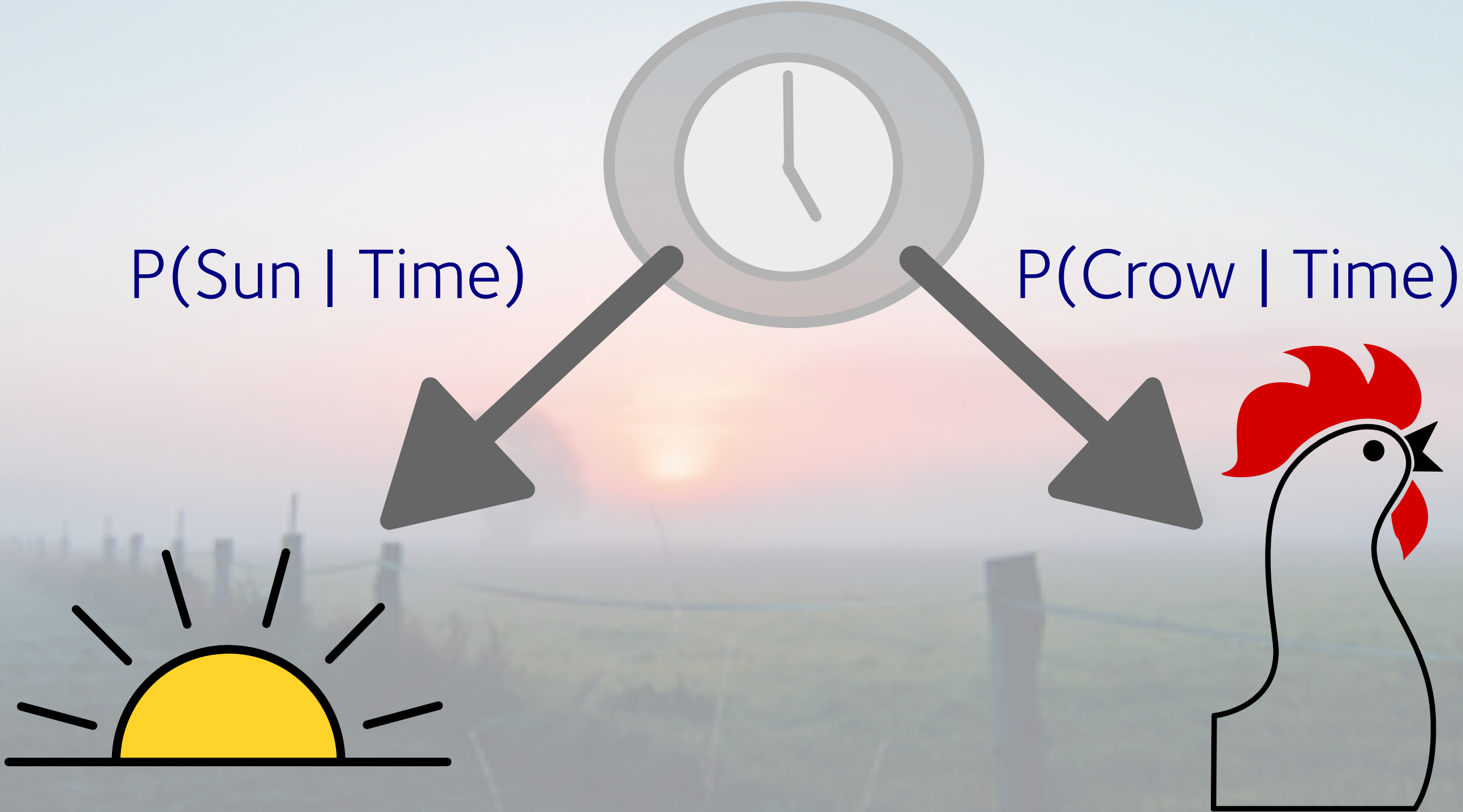
$P(\text{Crow} \mid \text{Sun})$



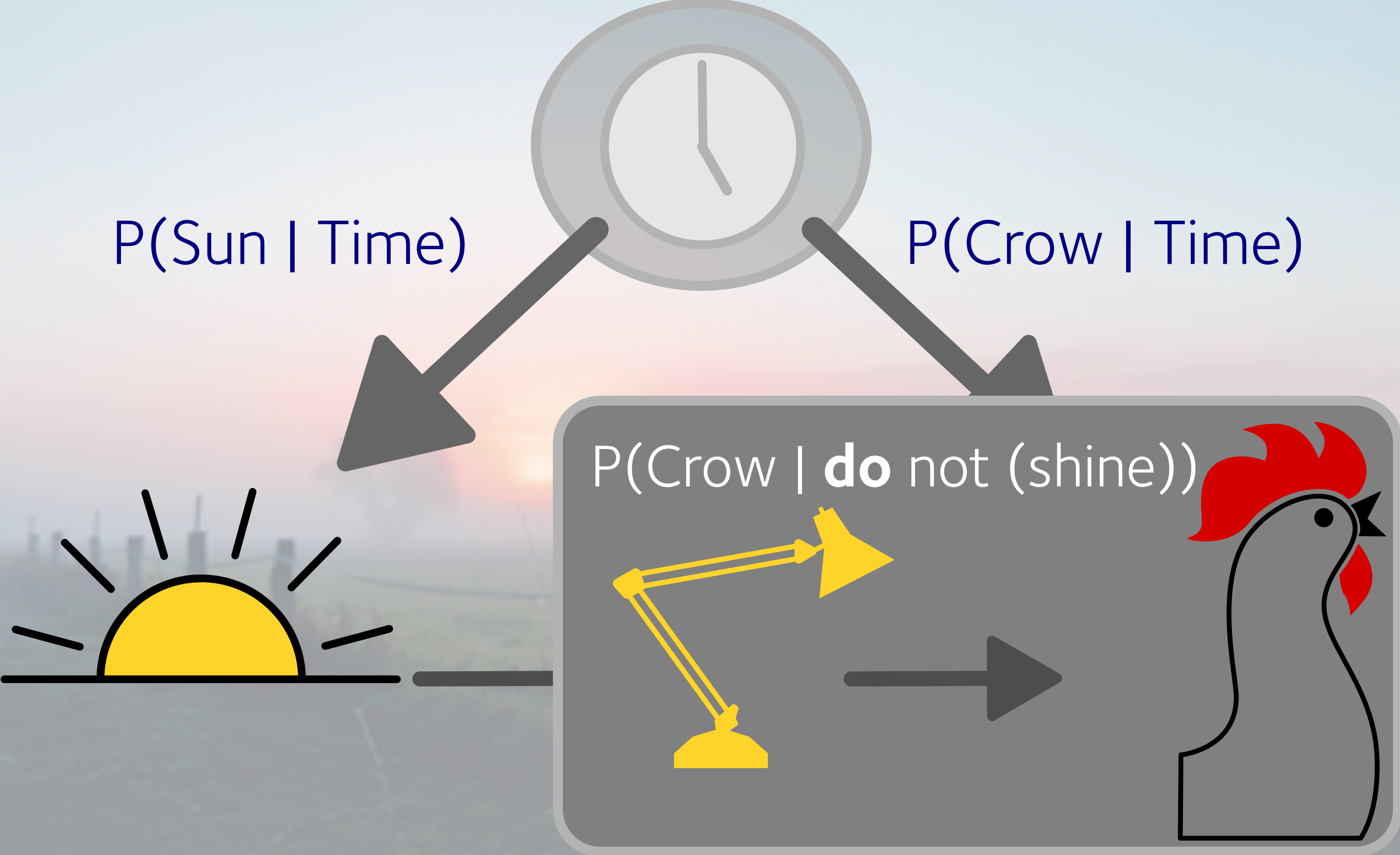
$P(\text{Crow} \mid \mathbf{do} \text{ not } (\text{Sun}))$



# Confounders are the cause

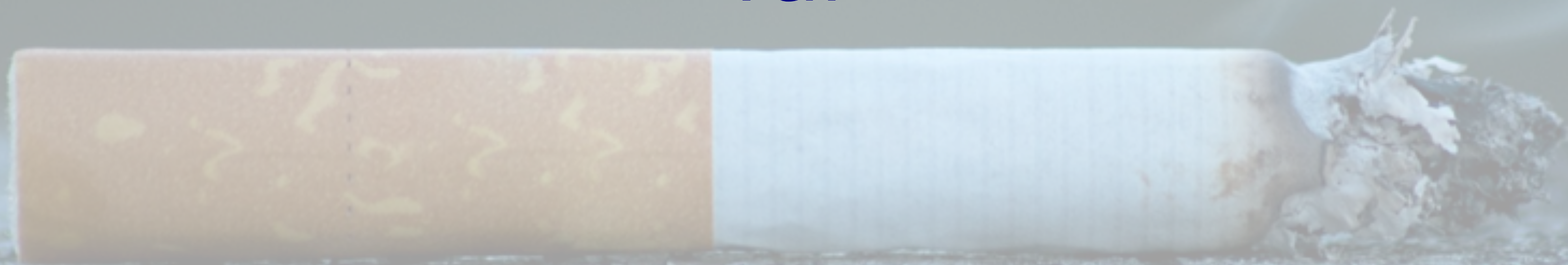
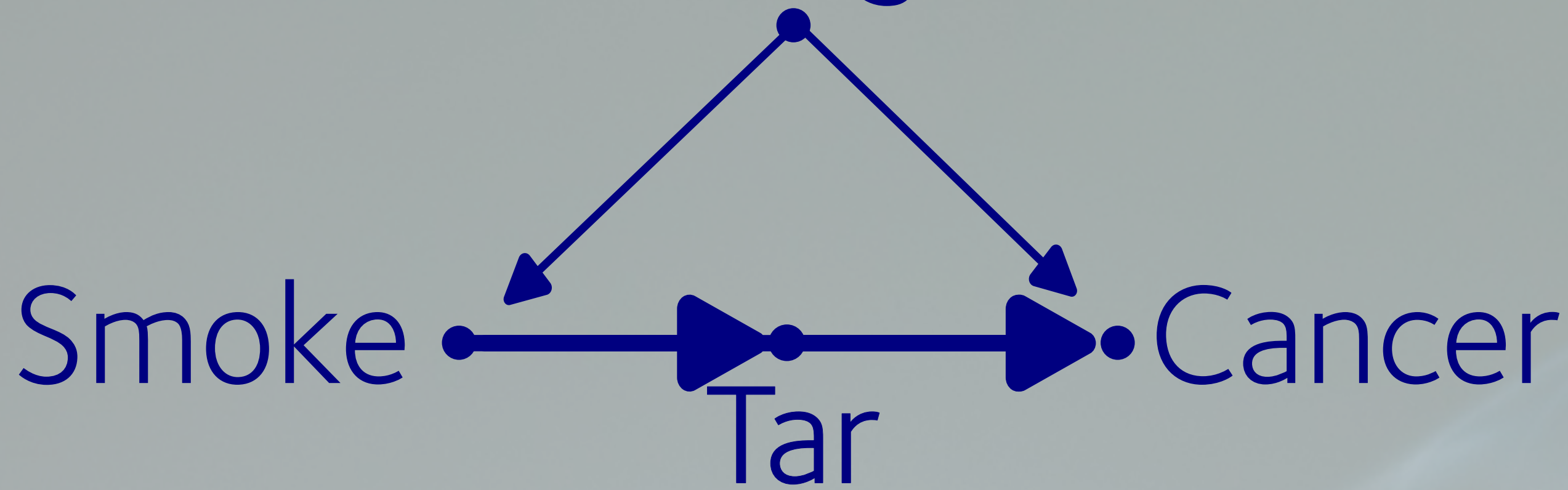


# Confounders are the cause





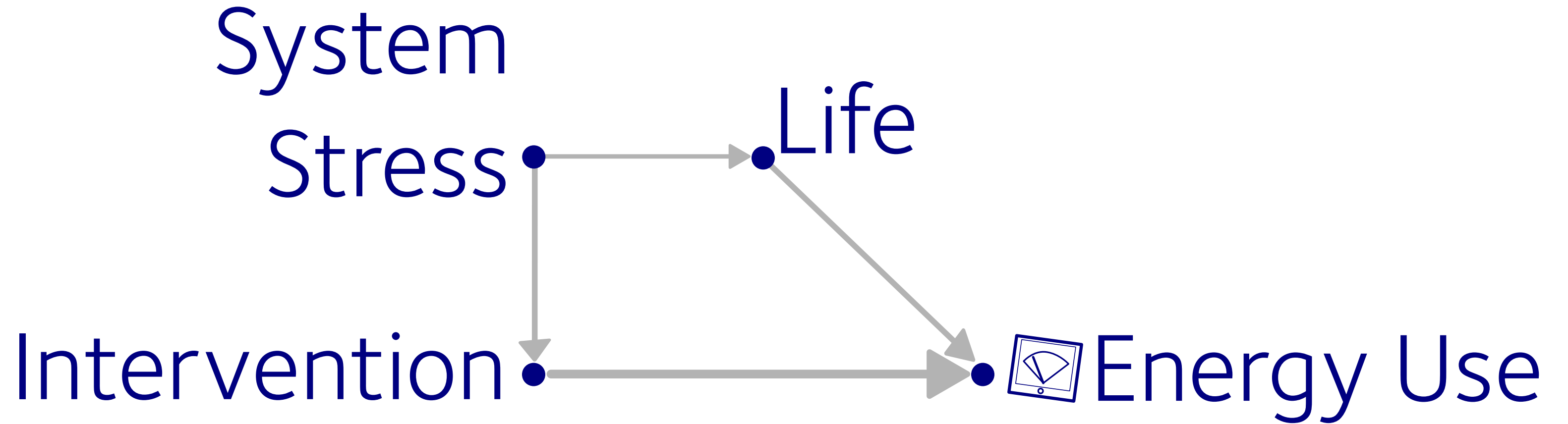
"Smoking Gene"



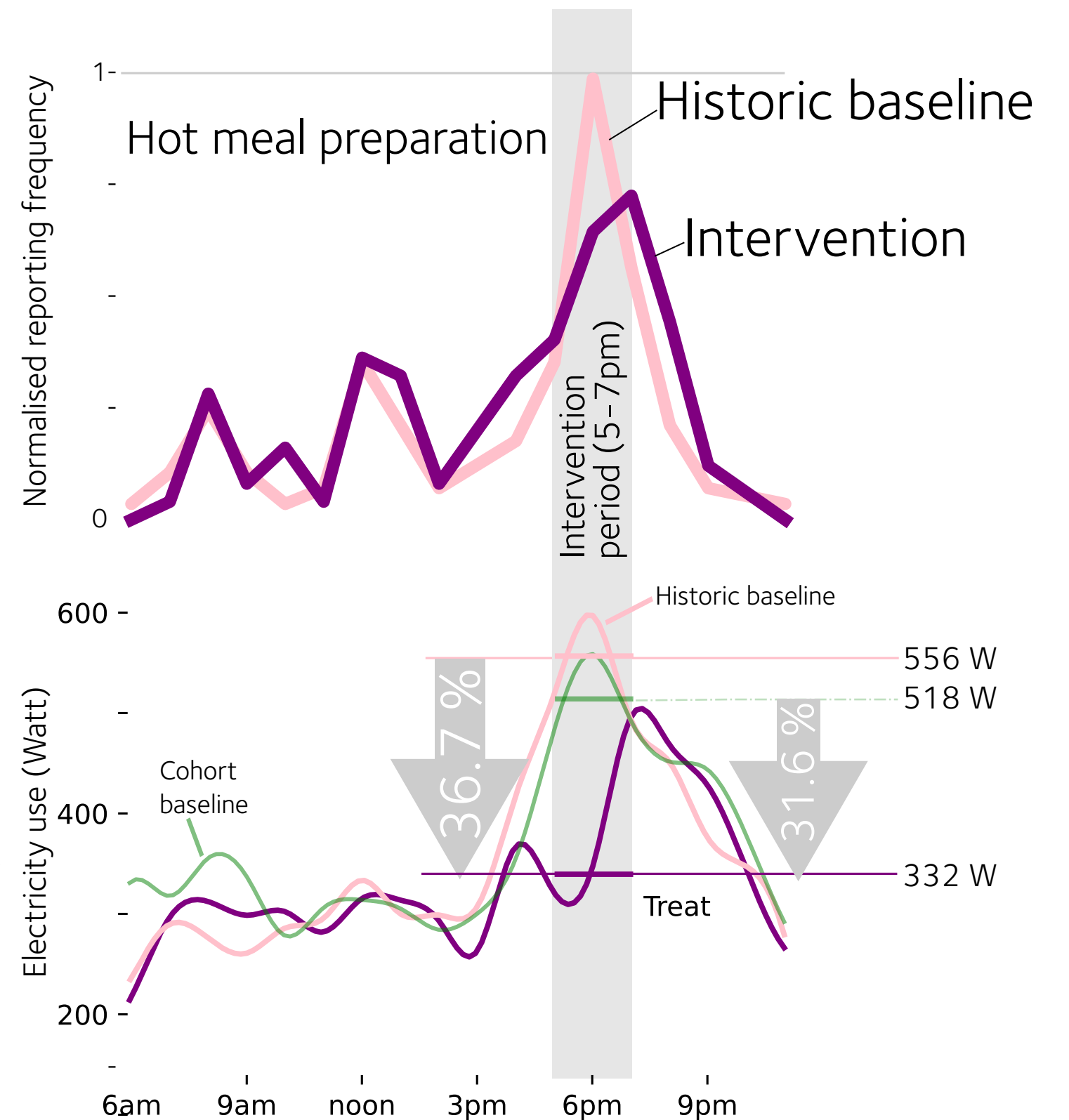
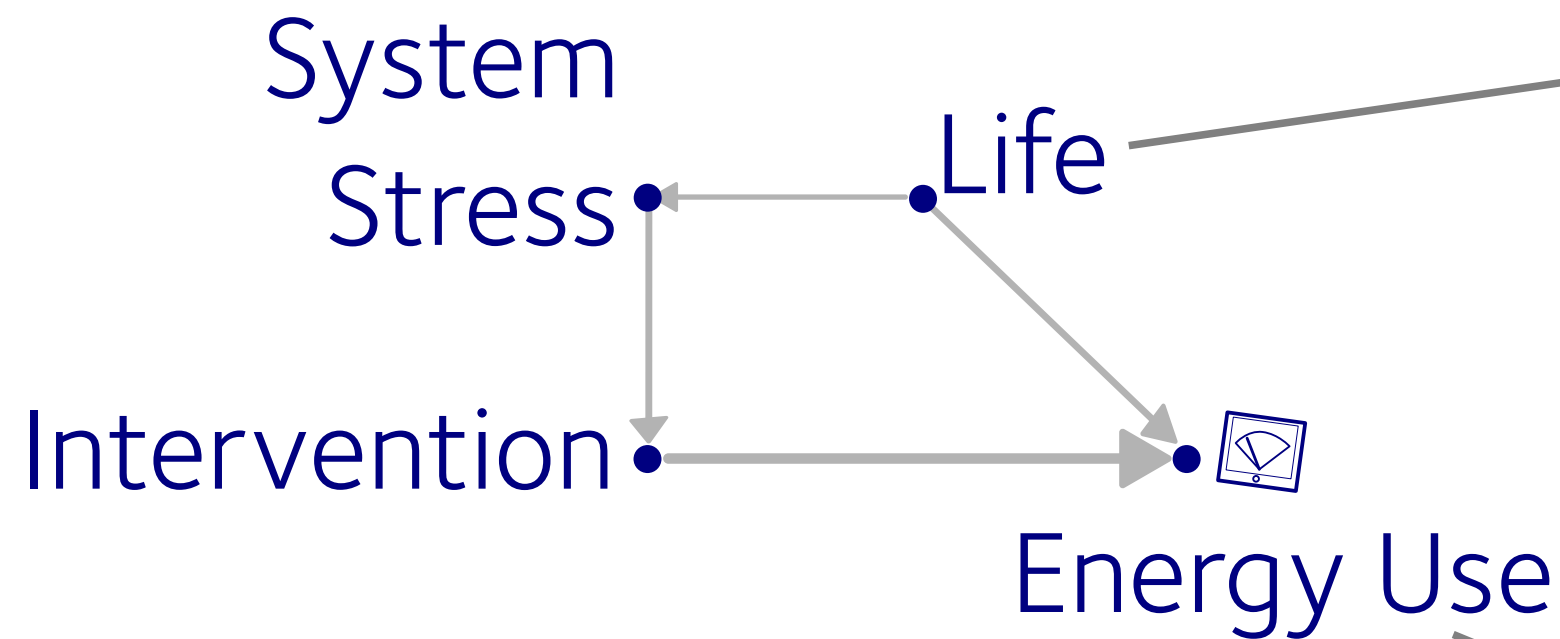
# Two energy examples of causality

- 1) Flexibility
- 2) Price elasticity

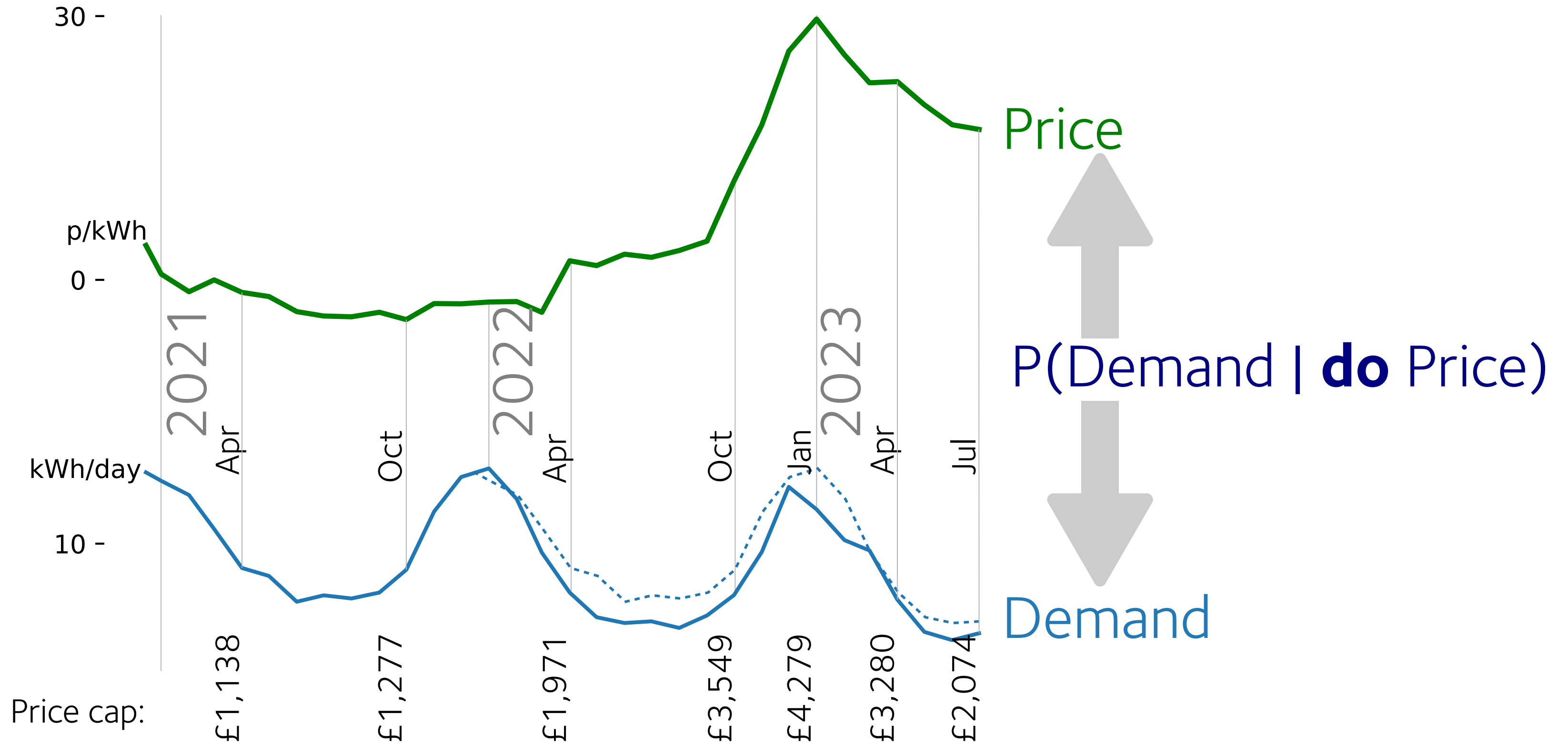
# Interventions cause flexibility



# Interventions cause flexibility



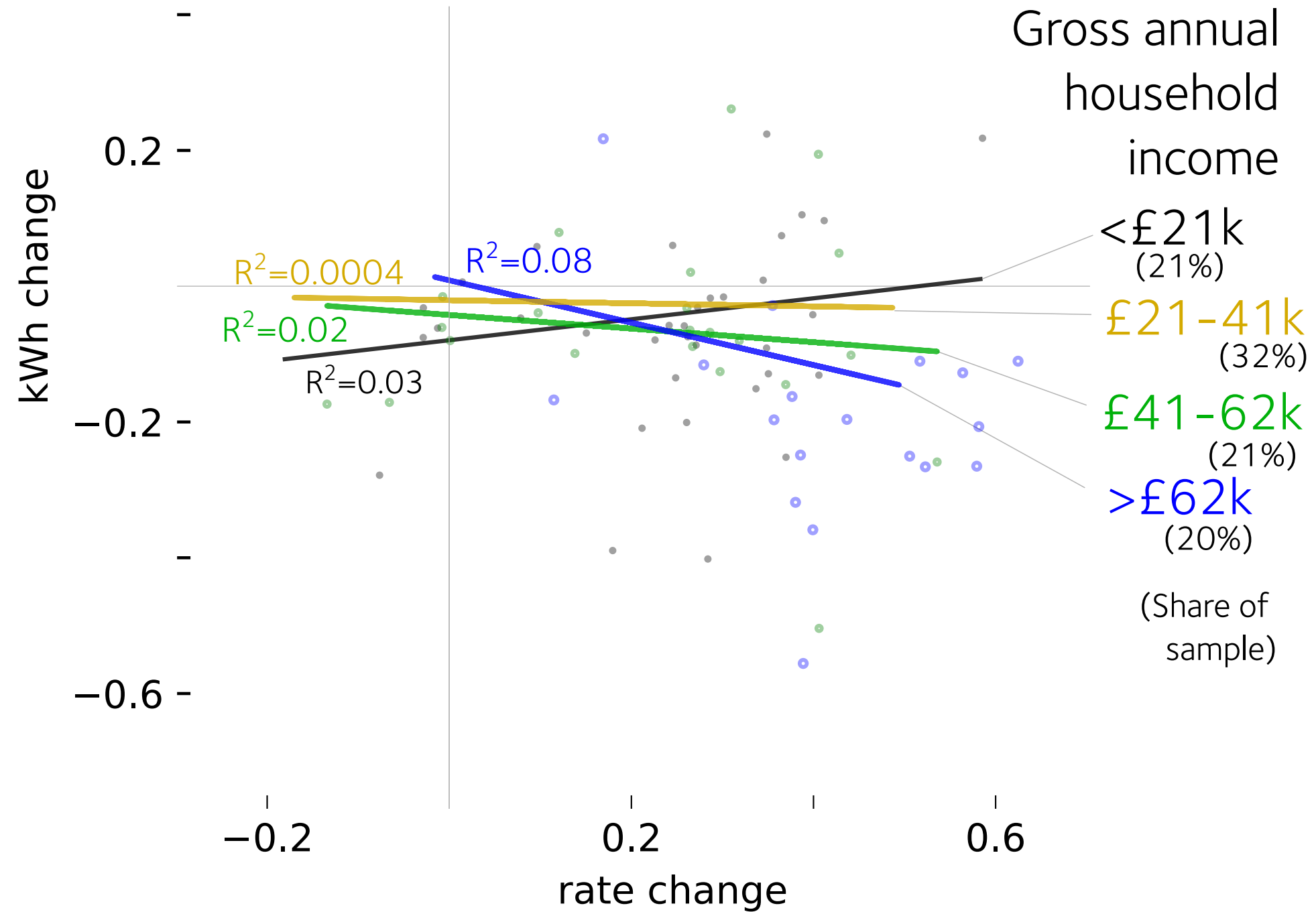
# Prices cause demand changes



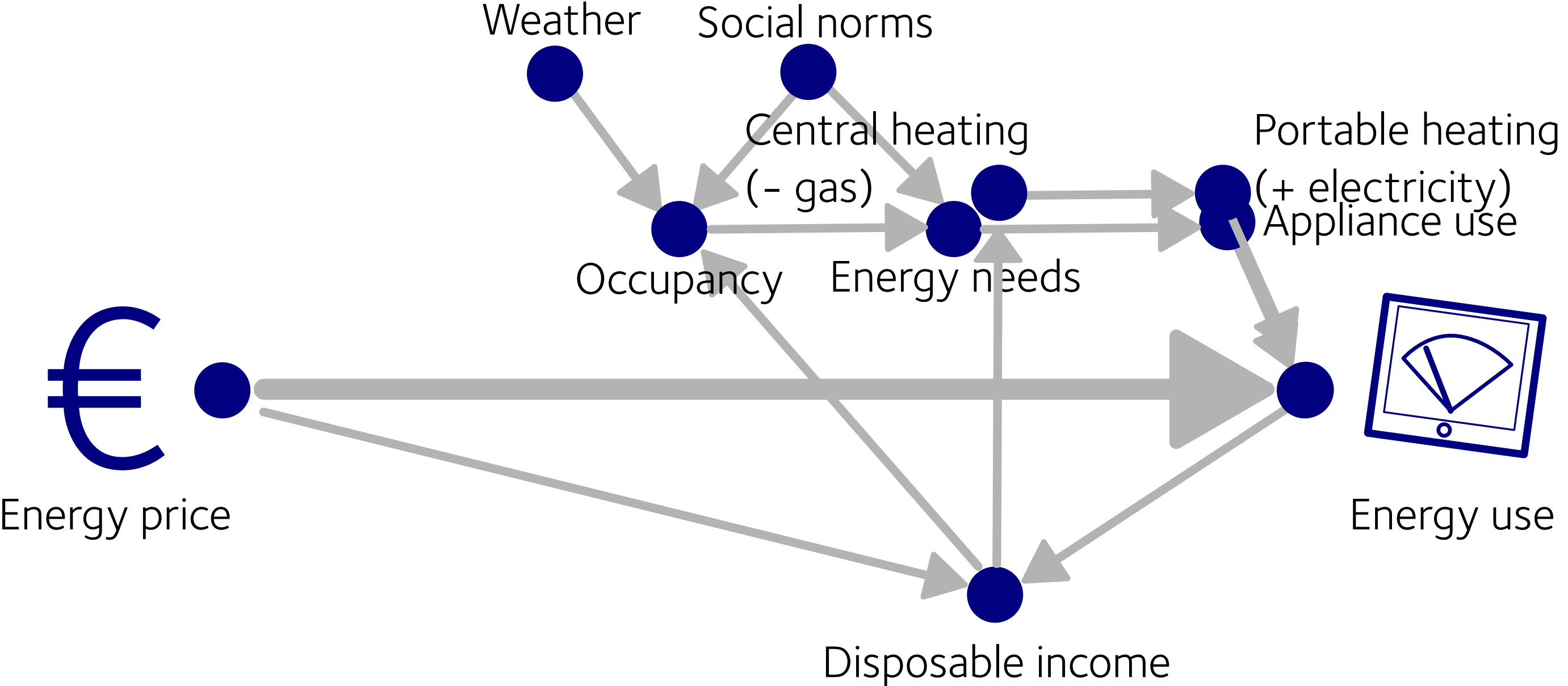
# Prices cause demand changes



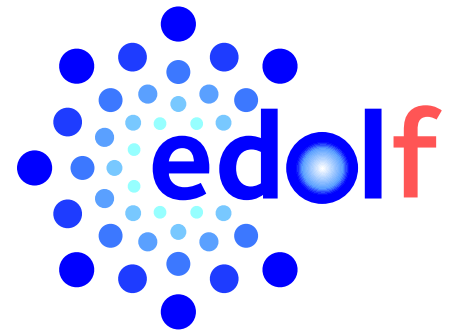
# Prices cause demand changes?



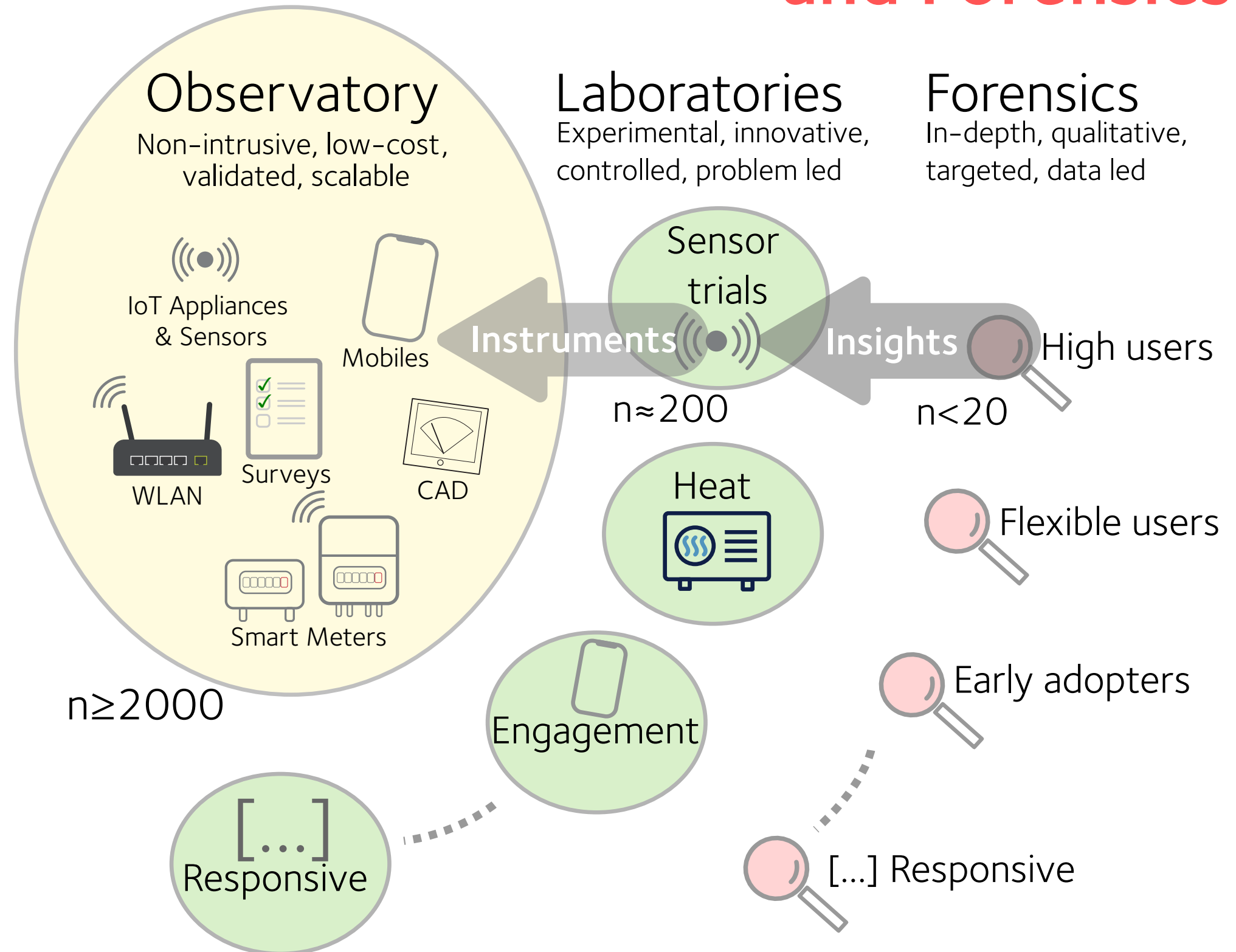
# Causality of price elasticity







# Energy Demand Observatory and Laboratory and Forensics



# Why are you here?

The door was open?

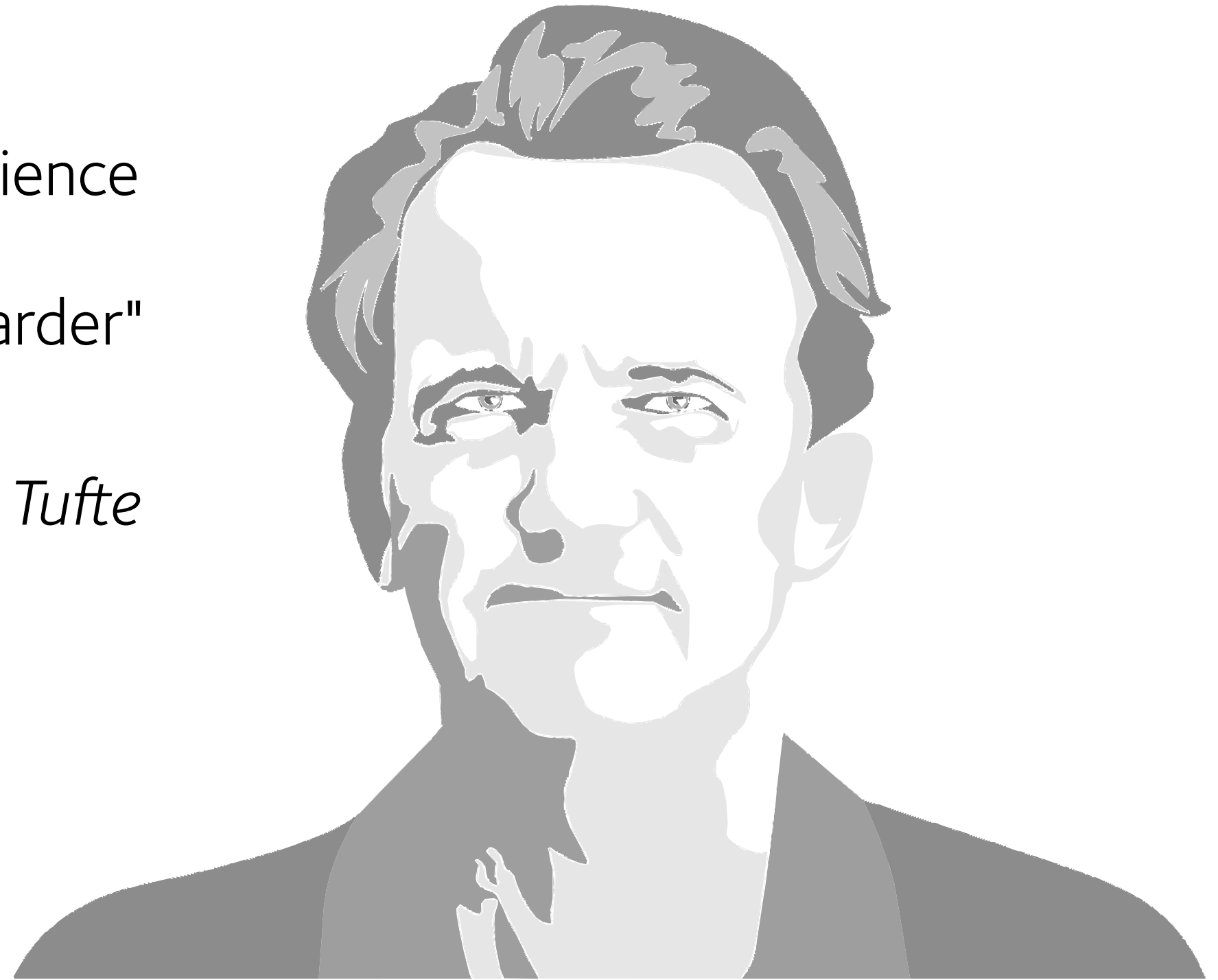


You are here

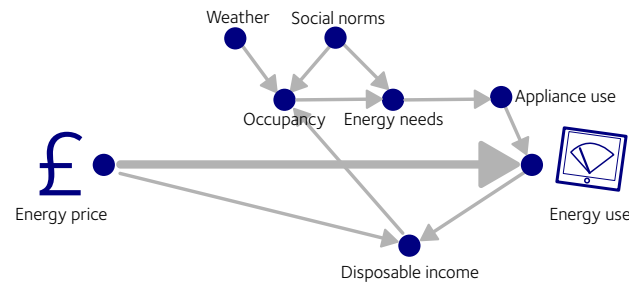
"Understanding human behaviour isn't rocket science

– it's harder"

*Edward Tufte*

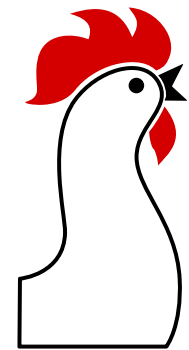


# Key takeaways



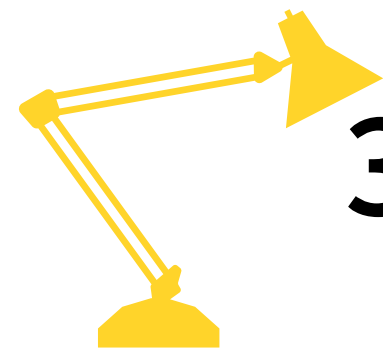
## 1. Causal models

helpful, but not trivial



## 2. Observations

the more and longer, the better



## 3. Interventions

need careful planning and control



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# Thank you

For grant  
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Engineering and  
Physical Sciences  
Research Council



Prof. Tadj  
Oreszczyn



Dr Tina  
Fawcett



Mr Simon  
Elam



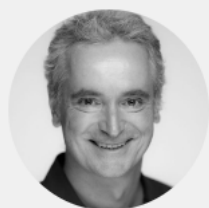
Dr Eoghan  
McKenna



Dr Zeynep  
Duygu Tekler



Dr Gesche  
Huebner



Prof. Christian  
Brand



Prof. Cliff  
Elwell



Dr Ellen  
Zapata-



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Crawley



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