

Applications of Environmental Economics and Behavioural Sciences in Policymaking

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What does the Environmental Behavioural Sciences and Economics Research Unit (EBERU) do?

Move Towards a Zero Waste Nation and Circular Economy

Build a Smart, Resilient and Sustainable Water System

Strengthen our Climate Change Resilience and Transition to a Low Carbon Future

Achieve Food Safety and Security Sustainably

Build a Liveable and Endearing Home

Rigorous **cost-benefit analysis** and **non-market valuation techniques** to assess resource efficiency and measure externalities

Econometric techniques to **evaluate policy impacts** and **benchmark environmental performance**

Behavioural insights to overcome cognitive and behavioural biases in order to build a **culture of sustainability**

Cost-Benefit Analysis

Case Study 1: Early Turnover Scheme to Mitigate Air Pollution

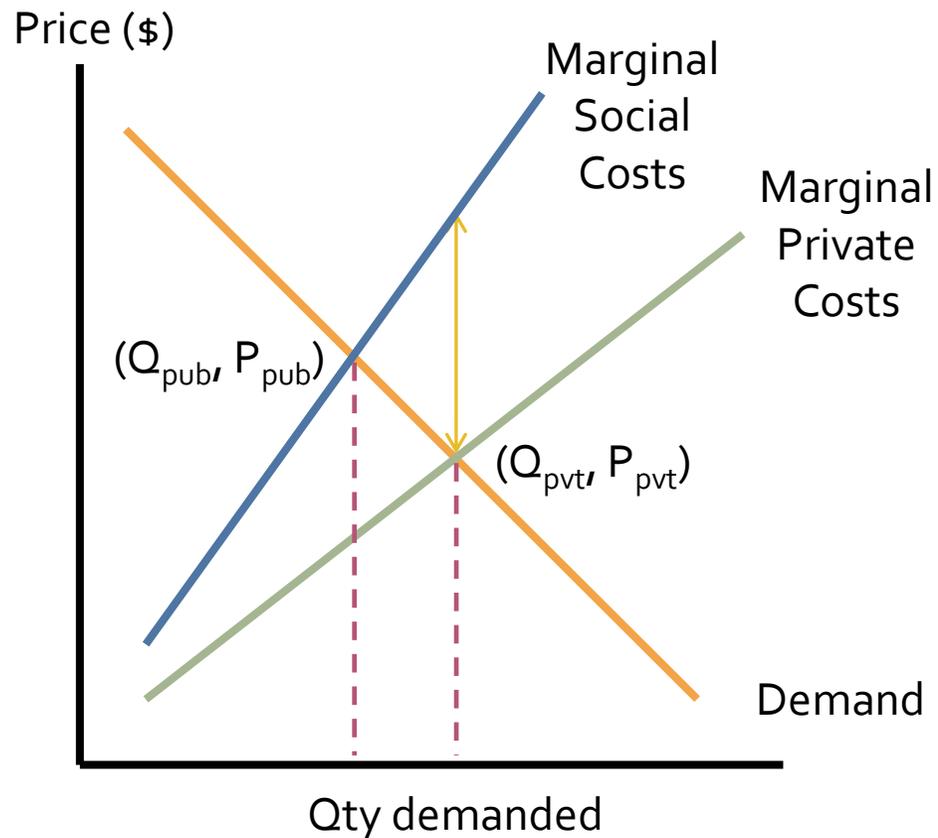
Air pollution is bad for human health

Pollutants such as PM_{2.5} cause adverse health impact

- Particulate matter 2.5 (PM_{2.5}) are tiny particles ($<2.5 \times 10^{-6}$ m in width!) that can travel deeply into the respiratory tract and cause various health issues
 - Short-term exposure can lead to increased respiratory symptoms and heart attacks
 - Long-term exposure can cause decreased lung function, development of chronic bronchitis, stroke and premature death
- One of the sources of PM_{2.5} is vehicular exhaust
 - As air quality standards are raised and technology advances over time, newer vehicles tend to emit less PM_{2.5} than older vehicles
- Is there a problem and what is the problem?
 - Market failure!



Market failure: Negative externalities

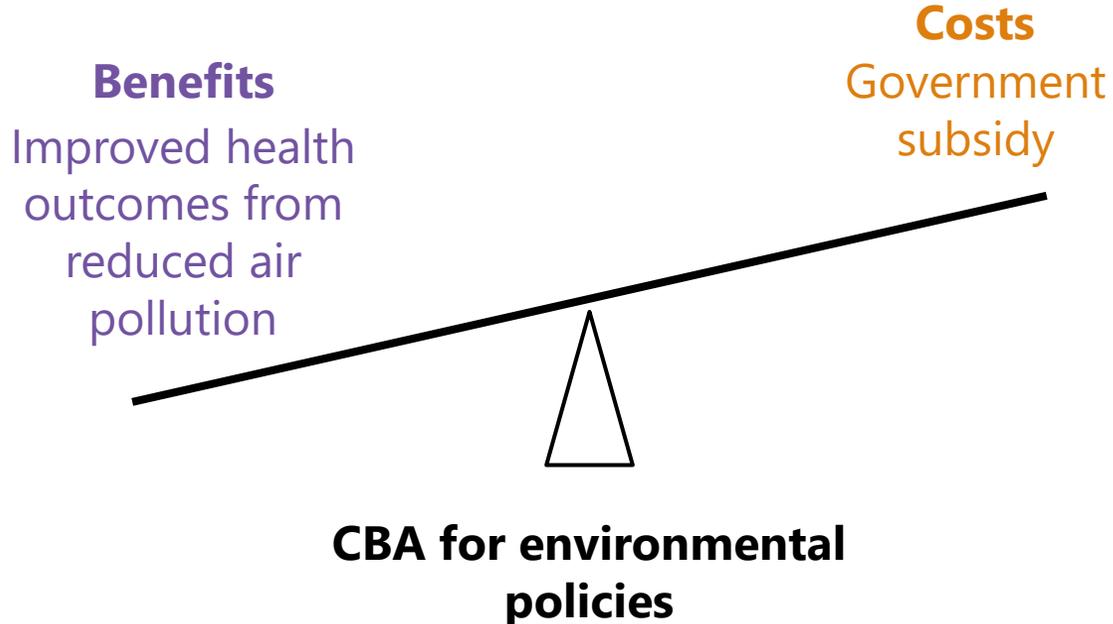


- Negative externalities result in marginal social costs being higher than marginal private costs
 - When people drive cars, they do not account for the negative health impact as a result of the pollutants from their vehicles' exhaust
- This leads to over-consumption of the good (driving, and more pertinently, more pollutive vehicles), with the socially optimal quantity $Q_{pub} <$ private optimal quantity Q_{pvt}

What can we do?

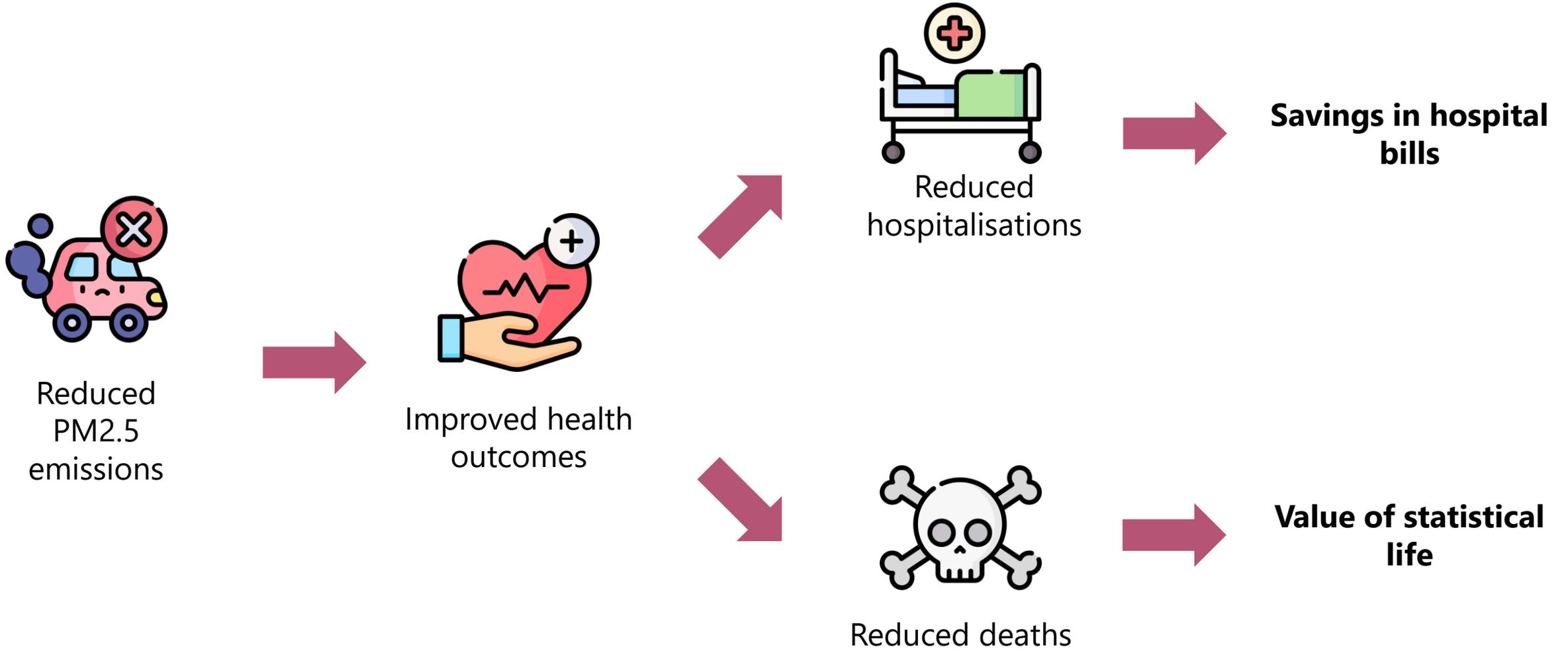
- In instances of market failure, one way to ameliorate it is government intervention
- One policy that Singapore has introduced to mitigate air pollution is the Early Turnover Scheme (ETS)
 - The ETS essentially gives vehicle owners a subsidy when they replace their older more pollutive vehicles with more environmentally-friendly models
- But how do we know whether to implement such a policy?
 - Cost-benefit analysis is one tool to evaluate policies!

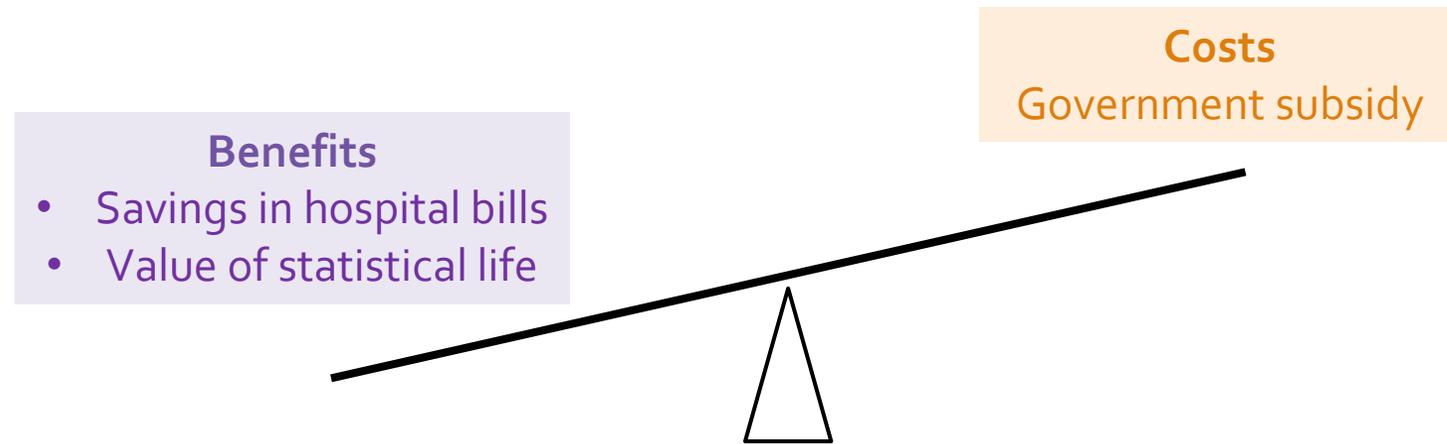
Cost-benefit analysis (CBA)



- CBA is a systematic approach to estimate the monetary value of costs and benefits of policies
- CBA can inform policy makers of the (potential) impacts of policies:
 - Carried out **before** policy implementation to understand the net benefits of the policy (*ex-ante* CBA)
 - Carried out **after** policy implementation to inform whether policies met their objectives and resulted in benefits for society (*ex-post* CBA)
 - If net benefits are positive, the policy leads to an improvement in welfare and should be implemented

How do we measure the benefits?





CBA for environmental policies

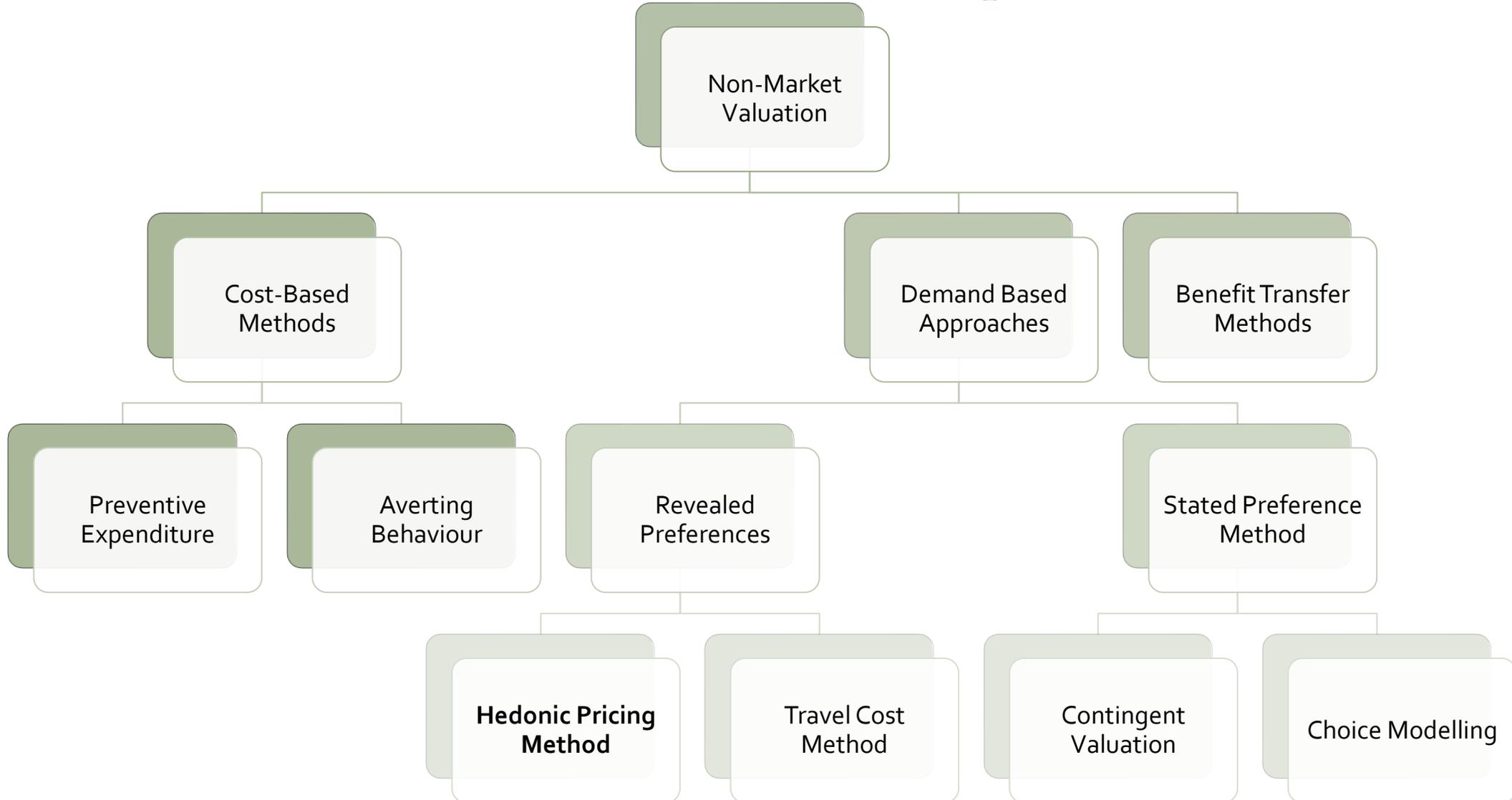
Case Study 2: ABC Waters to transform waterways

Environmental goods typically have no prices, how do we do a CBA then?

The Active, Beautiful and Clean Waters (ABC Waters) programme was launched by PUB in 2006 to transform Singapore's drains, canals and reservoirs

- We learnt earlier that it is useful to conduct a CBA to evaluate programmes
- While the costs (i.e. government expenditure) are clear, the benefits of environmental policies are usually much harder to quantify
 - Usually we can use market price as an estimate of the economic value of a good
 - Demand: Maximum price that consumers are willing and able to pay for a good
 - However, environmental goods typically have no market prices as they are not traded in markets
- As such, we have to find alternative ways to estimate their value
 - Non-market valuation!
 - Estimate monetary value of goods and services that do not have an existing market

An overview of non-market valuation techniques



How do people make choices?

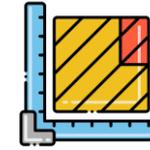
Suppose an individual is choosing a house to buy...



...the individual will likely take into account a range of factors



Price of house



Floor area



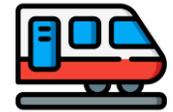
Distance to schools



Distance to park



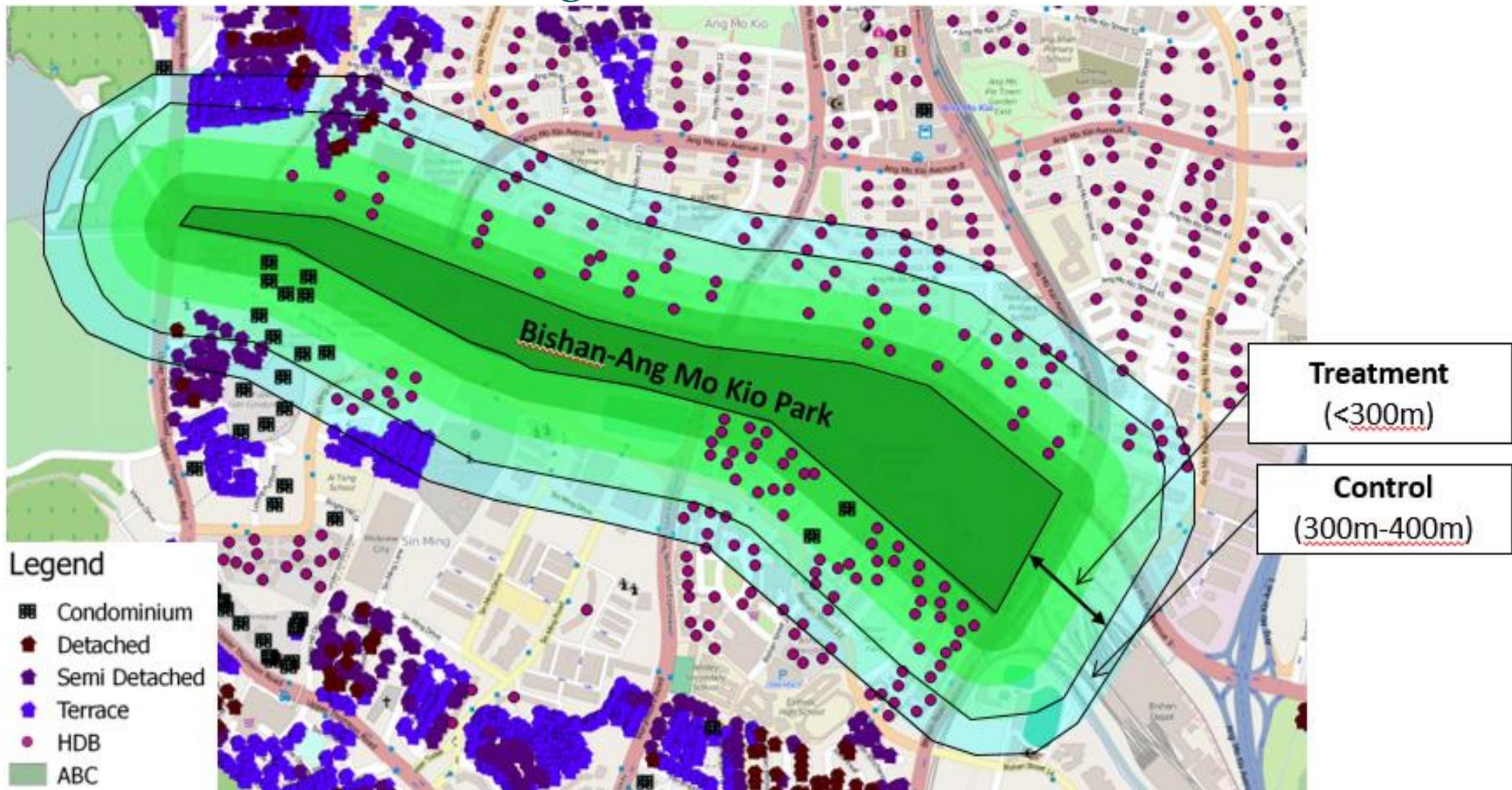
Facing of the house



Distance to MRT

Hence, when a good is purchased, individuals indicate that they prefer the combination of characteristics of that good, given their budget constraints

Visualisation of Bishan-Ang Mo Kio Park



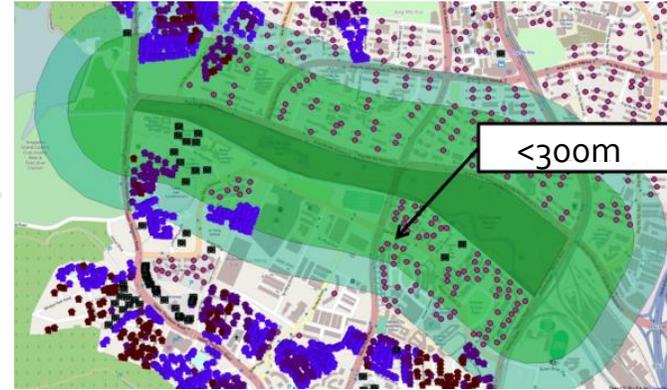
Methodology

Before construction
(2009)

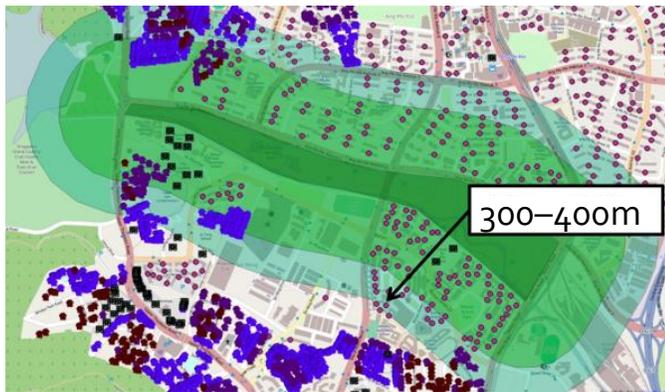


Properties close to park: **treatment group**

After construction
(2011)



Compare difference in resale price trends to obtain effect of ABC Waters

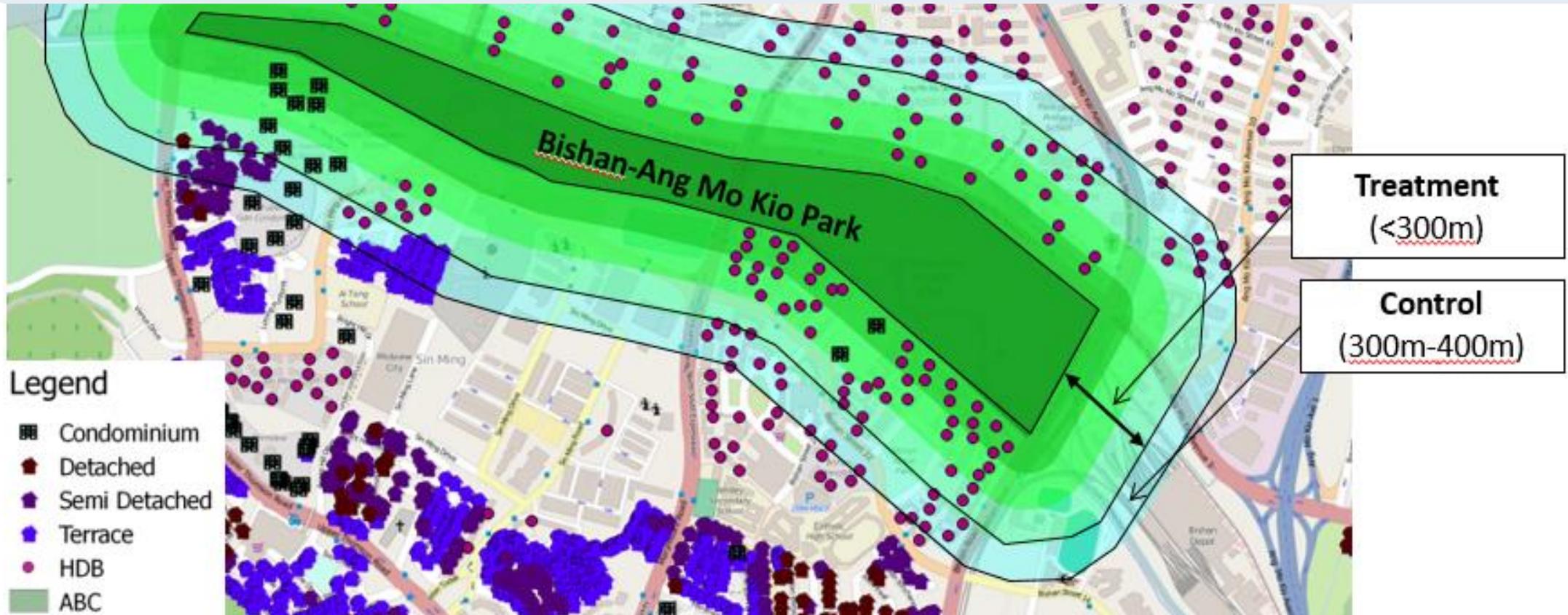


Properties further from park: **control group**



Results

There was a significant increase in resale prices for properties in treatment group. This increase more than offset costs of ABC Waters programme



Hedonic Pricing in Practice

- To conduct a hedonic pricing study, we generally follow a step-wise process

Identify an appropriate proxy market

Specific to ABC Waters, we estimated the impact of the project on housing choice and, therefore, the impact on house prices

Collect relevant data

We collect resale and house characteristics data from URA's Realis and data.gov.sg; ABC Waters data was obtained from PUB

Analyse the data with statistical models to understand the impact of the environmental good

We used a panel regression model to estimate the impact of ABC Waters on house prices

Behavioural Insights

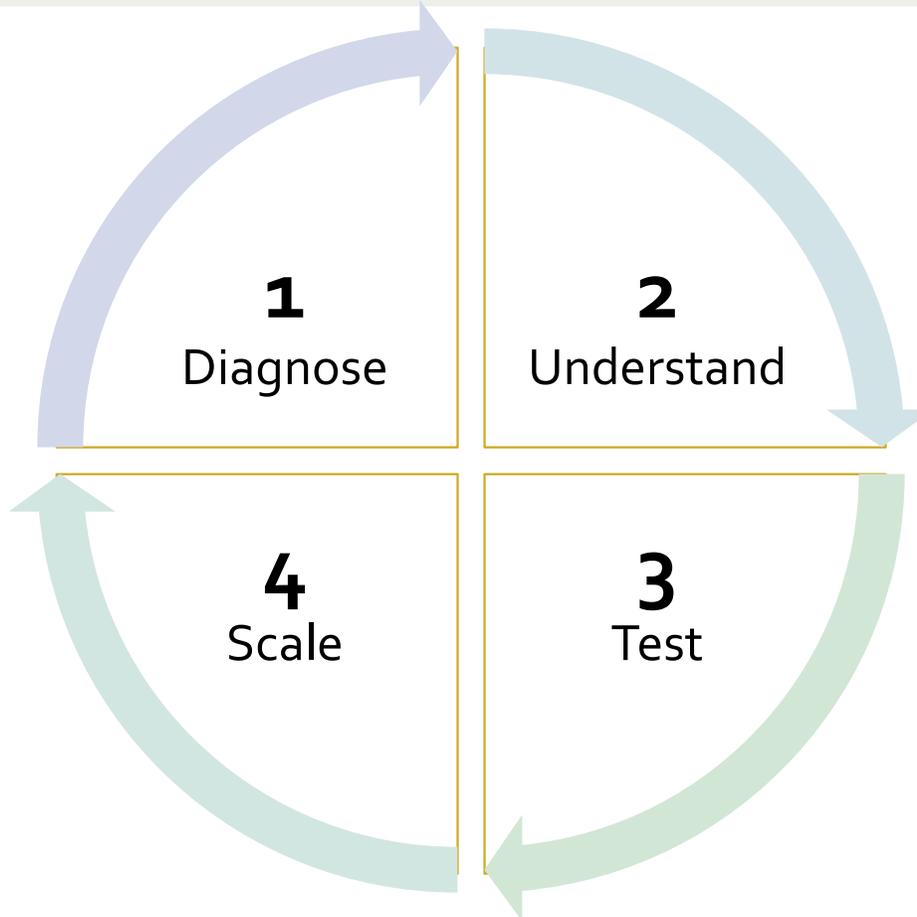
What is Behavioural Insights?

- In classical economics, we view humans as rational actors who know how to maximise their own utility
- A rich and growing area of research has sought to relax the assumption that humans are rational (for example, Thaler (2008) and Kahneman (2011))
- By applying insights from across the social sciences, Behavioural Insights (BI) seeks to understand human behaviour and influence their behaviour with nudges
- We can apply BI to inform the design of public policy, allowing people to overcome their cognitive barriers and biases to act in a socially desired manner

EBERU's CAM Framework

EBERU developed a framework to understand barriers and enablers of behaviours, which is used to inform the design of interventions

- Understand the decisions that people make with a journey map
- Enables identification of behaviours that could be nudged at the margin



- Use the **C**ontext, **A**bility, **M**otivation lens to understand the conditions that enable and prevent desired behaviours

- If interventions are deemed to be successful in nudging behaviour, explore the scaling of the intervention

- Evaluate proposed interventions with randomised controlled trials

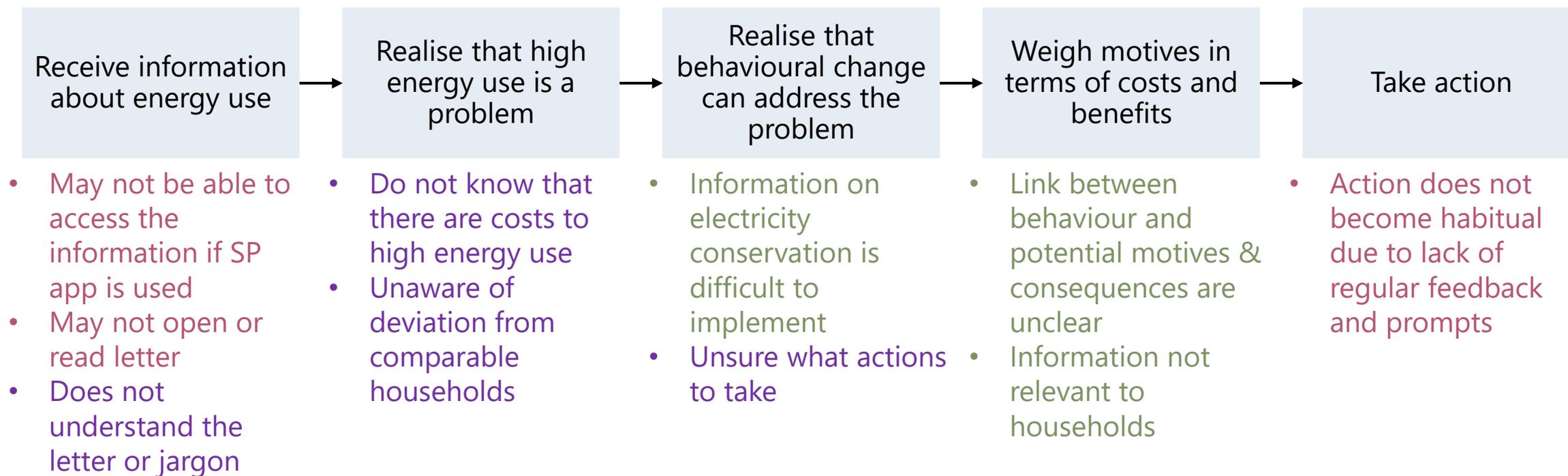
Case Study 3: Customised Household Energy Efficiency Reports to improve energy conservation

We want to improve energy conservation, but how?

- Energy conservation is important and has benefits
 - Higher monetary savings
 - Lower carbon emissions
 - Conserves precious resources (e.g. fossil fuel)
- However, humans may not always behave rationally due to cognitive barriers
 - How can we overcome this and encourage energy conservation?
 - Behavioural insights!
- Specifically, we apply behavioural insights to design customised household energy efficiency reports (CHEER) to encourage energy conservation

Journey mapping the CHEER intervention

Using insights from a survey and the **Context, Ability, Motivation** framework, we identified key barriers to energy conservation



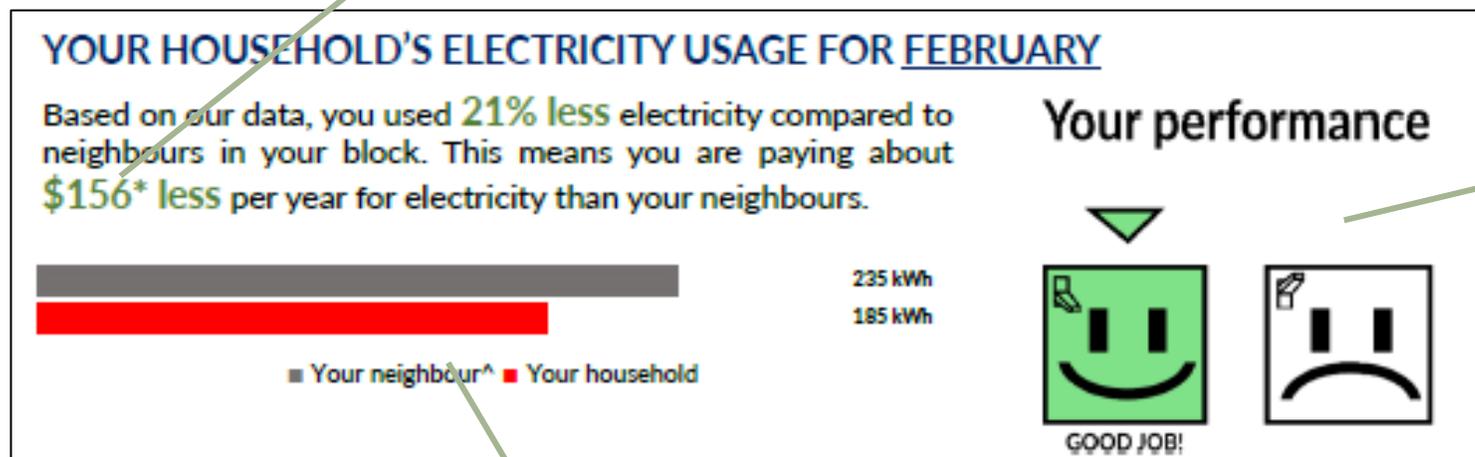
Identification of these barriers enabled the design of the hardcopy report

Designing the CHEER intervention

To address the barriers on understanding the information in the bill, we sought to simplify the messaging in the CHEER

Barrier: Do not know that there are costs to high energy use; link between behaviour and potential consequences are unclear

Intervention: Target household's loss aversion by highlighting savings from energy conservation



Barrier: Does not understand the letter

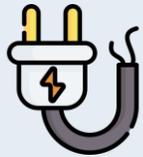
Intervention: Use of colours and emoticons to signal improvements or otherwise; energy usage is framed in dollar terms instead of kWh (which is more difficult to understand)

Barrier: Unaware of deviation from comparable households

Intervention: Comparisons with similar house-types to benchmark behaviour

Results

- Customised hardcopy reports were mailed monthly to the Treatment Group from Dec-19 to May-20. The electricity consumed by these households was compared against a Control group who received the usual (uncustomised) reports
- CHEER was effective in reducing monthly household electricity use amongst the treatment group. This resulted in:



Electricity savings



Cost savings

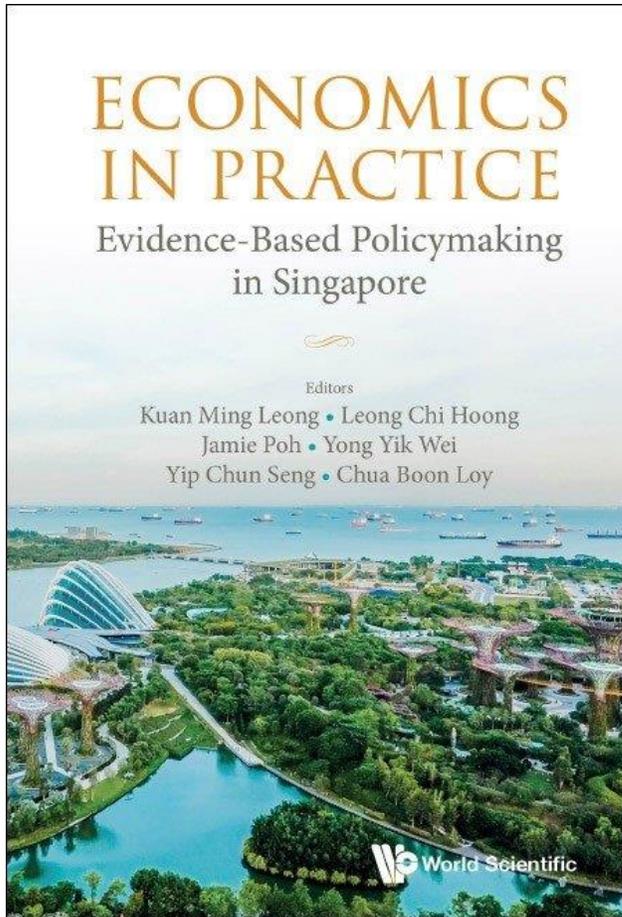


Carbon savings

Conclusion

- We can, should and do apply economics and behavioural sciences to inform the design and implementation of environmental policies
 - **Cost-benefit analysis** is a tool that could be used to inform whether policies should be implemented
 - For environmental goods, **non-market valuation techniques** could be used to quantify their benefits
 - Well-designed **behavioural interventions** could help people overcome cognitive barriers and biases to act in a socially desirable manner

Economics in Practice: Evidence-Based Policymaking in Singapore



For 20% off, use the
promo code
"WSE20"

- To commemorate the Economist Service's (ES) 20th anniversary, we have published a book that affirms the importance of economic analysis in the formulation of Singapore's public policies
- The book comprises three sections that span various policy domains in Singapore:
 - I. Economic Policies. Economic growth, trade and investments, productivity and innovation, industrial development, the enterprise landscape and manpower
 - II. Socioeconomic & Security Policies. Income inequality and mobility, families, healthcare costs and crime
 - III. Infrastructural Policies. Environment, housing and land transport
- The book is available from World Scientific's website or at Books Kinokuniya

Thank you