



Towards energy behaviour change

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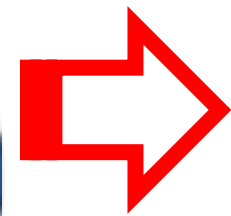
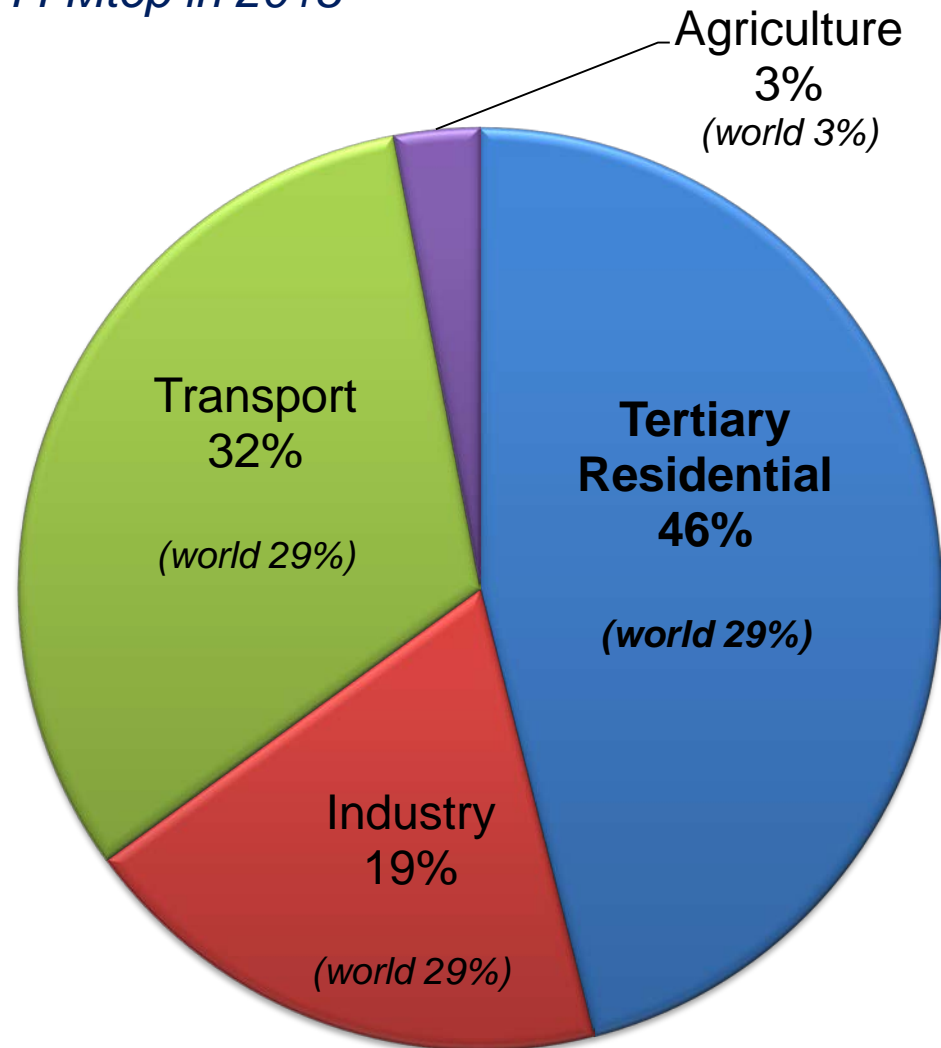
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Energy consumption: an increasing environmental issue



FRENCH FINAL ENERGY CONSUMPTION BY SECTORS

TOTAL : 144 Mtep in 2018



Most energy consuming sector

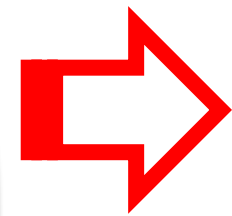
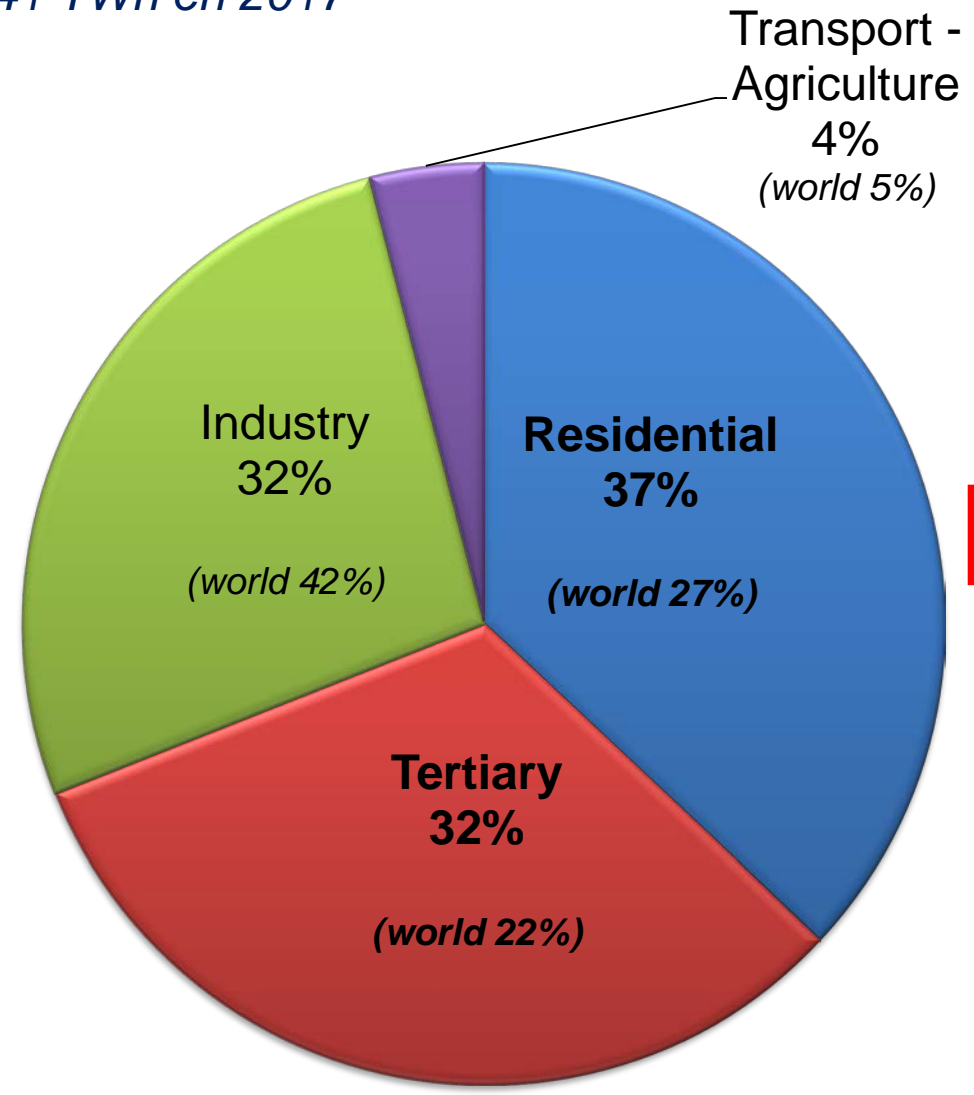
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FRENCH FINAL TOTAL ELECTRICITY CONSUMPTION BY SECTOR

TOTAL : 441 TWh en 2017



Higher contribution from residential and commercial sectors to the total electricity consumption

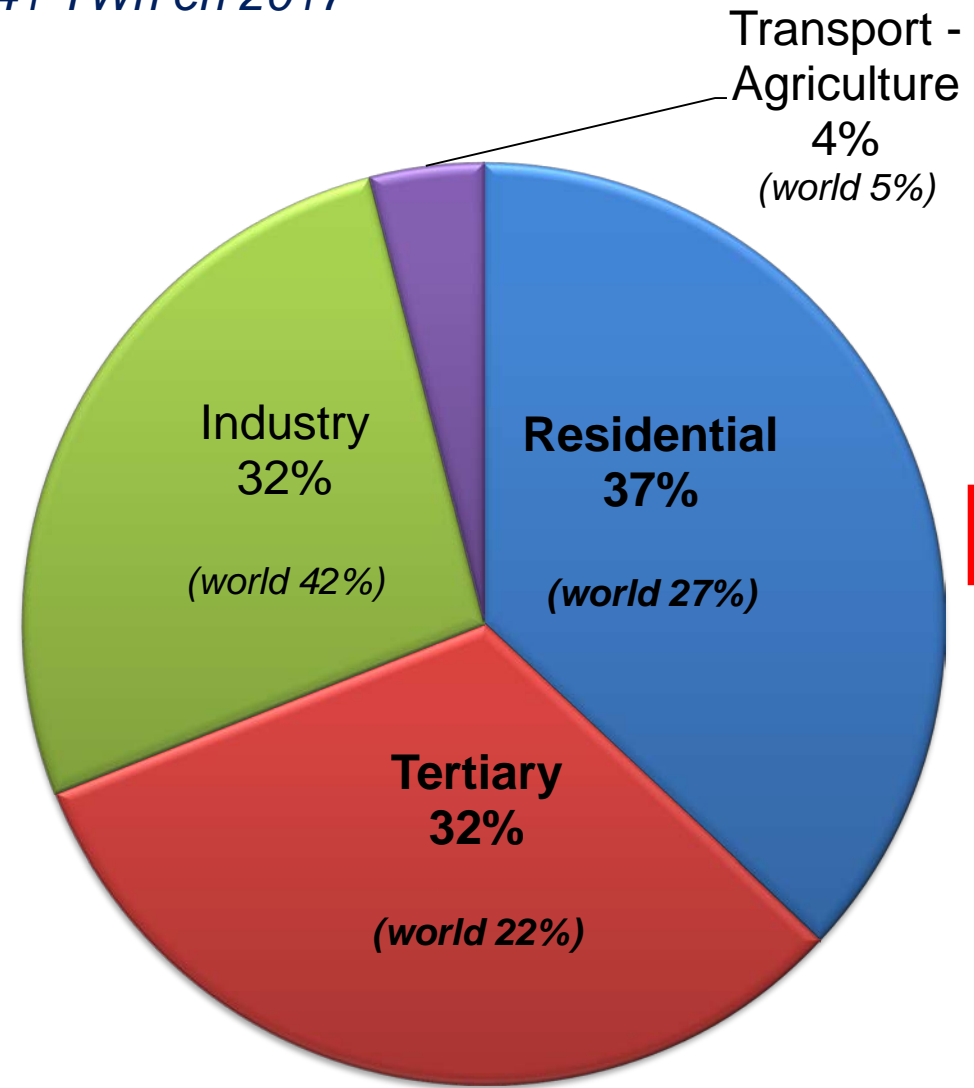
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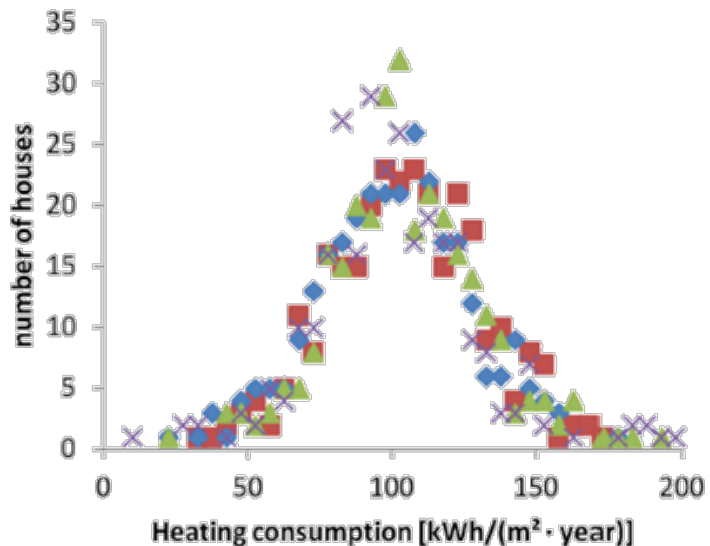


Higher contribution from residential and commercial sectors to the total electricity consumption

Potential of savings

Energy consumption: building performance gap

Difference between predicted energy performance and real measured one



Distribution of heating consumptions for 290 similar houses (Andersen, 2012)

Data collected from five case study buildings showed that **actual energy consumption** can be five times **higher** than **predicted** one

(Carbon Trust, 2011)

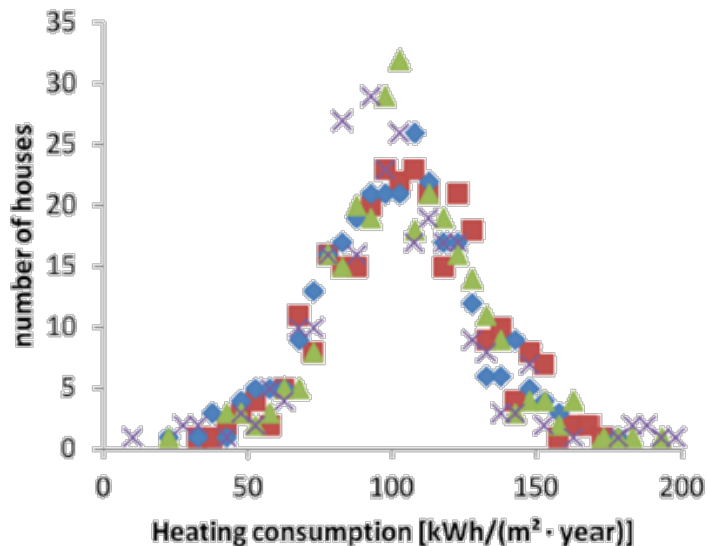
Energy consumption can vary **enormously** even for neighbours living in the **same type** of house.

Difference of **51%**, **37%** and **11%** in heat, electricity and water consumptions between **similar** houses.

(Gill et al., 2010)

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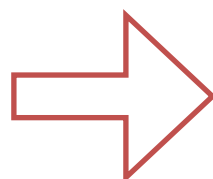
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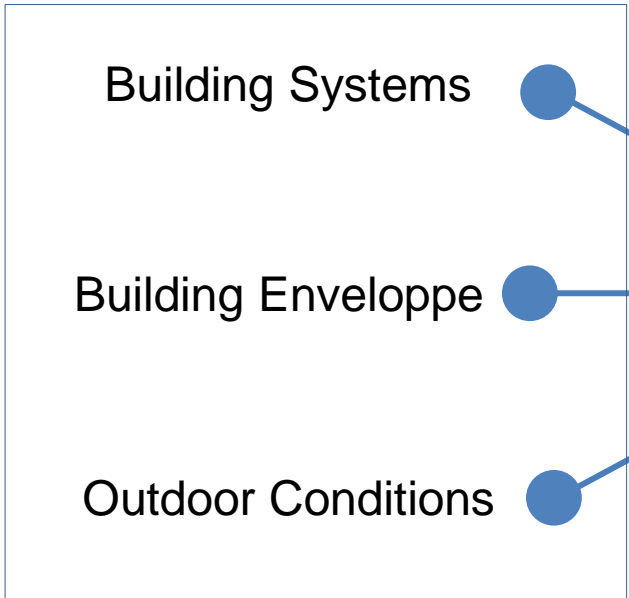
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“Buildings don’t use energy: people do” [Janda, 2011]

Energy consumption: performance gap

Technical and physical Factors



Building Performance



Human Factors

Occupant behaviour



Indoor Comfort

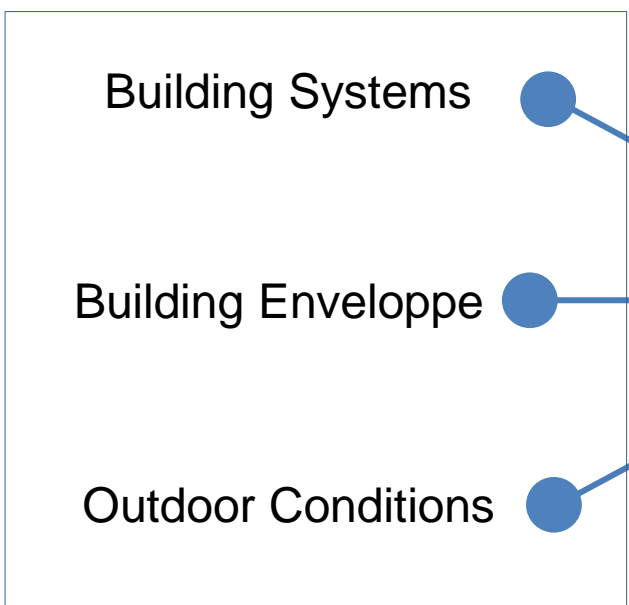


Total Energy consumption in Buildings



Energy consumption: performance gap

Technical and physical Factors



Human Factors

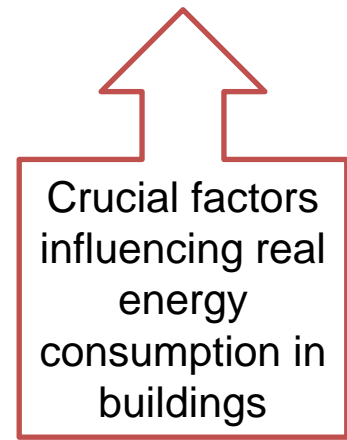
Occupant behaviour

Indoor Comfort

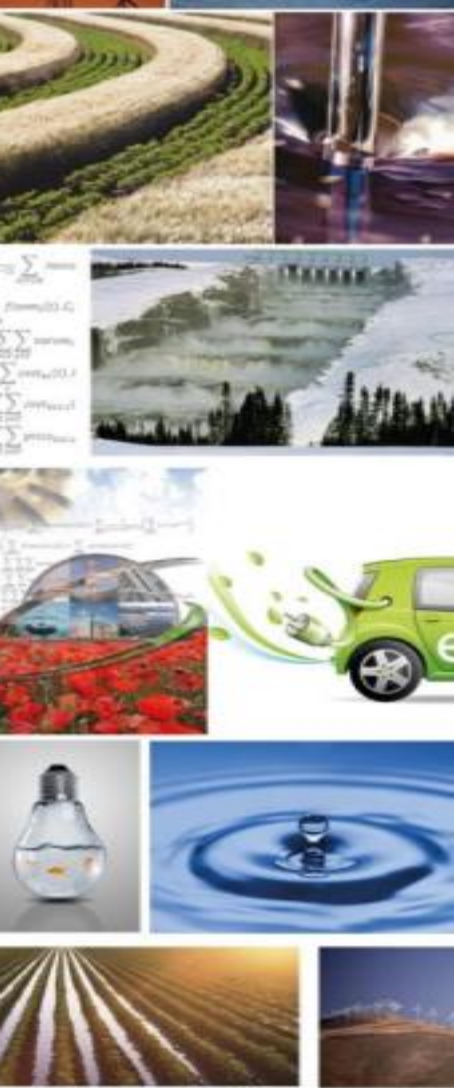
Building Performance



Total Energy consumption in Buildings



Importance of understanding occupant's behaviour in buildings



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Energy consumption: understand and predict



- Many research works aiming the prediction of building energy consumption using Artificial Intelligence
 - Study of variable effects by Machine Learning
 - Neural Networks Models to predict building energy consumption
 - Deep learning to predict cooling and heating loads ...
- The role of AI
 - Giving more importance to the human factor while predicting energy consumptions
 - Studying the impact of occupants' behaviour change on the reduction of energy consumptions by exploring different scenarios
 - Developing a global solution that can be applied to different types of buildings in order to estimate energy consumptions while taking into consideration occupants activities

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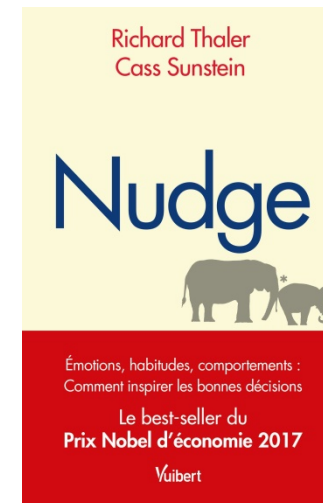


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- How can we change occupant behaviour in buildings in order to reduce energy consumption?

Changing behaviours: Nudge Concept

The development of behavioural sciences has raised interest for non-price energy conservation policies

“A nudge is any aspect of the **choice architecture** that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives.”
 [Thaler et Sunstein , 2008]



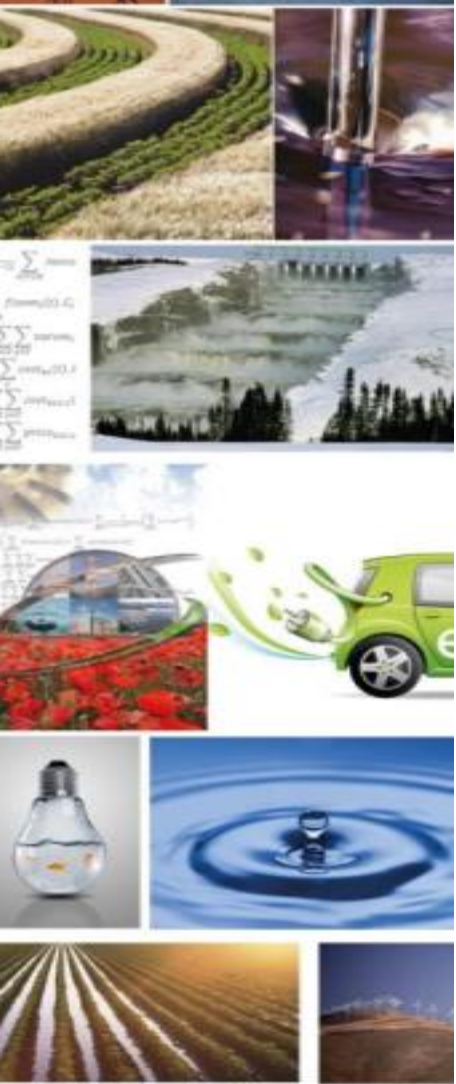
Changing behaviours: Nudge Concept



- Without any message
 ⇒ **2,5 %** turned off the lights
- “Please turn off the lights when you leave”
 ⇒ **5%** turned off the lights
- “93 % of people are caring about the planet. What about you ? »
 « So, why don't you turn off the lights when you leave ?
 ⇒ **40% turned off the lights**



Changing behaviours: example from a field experiment



- 3 nudges tested in office buildings (tertiary environment)
 - Moral appeal (*weekly messages expressing a responsible consideration, human consequences of global warming*)
 - Social comparison (*weekly reports with peer comparisons of electricity use*)
 - Stickers (*simply give information on good practices on energy consumption*)
- Particular kinds of information that can be used or not by employees
- Every workers know that others receive the same information
 - The different nudges affect the weight a worker gives to peer pressure
- Result: decreasing energy consumption
 - Nudges more effective when combined

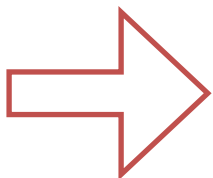


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NUDGE



Transform incentives to actions by making individuals choose the wished decision

A low cost solution

Use of cognitive biases

No use of financial incentives or order

Doesn't affect choices based on explicit preferences



“To count as a mere nudge, the intervention **must be easy and cheap to avoid**. Nudges are not mandates. Putting fruit at eye level counts as a nudge. Banning junk food does not.”
 [Thaler et Sustein , 2008]



Changing behaviors: Challenges



- The challenges around buildings energy consumption are one of the key pillars of the energy transition
 - A significant potential of energy saving
 - A better demand management would allow a more optimal management of the means of production (which will be more and more intermittent with the deployment of local renewable energies)
- Nudges as an interesting tool for energy savings
 - A low cost solution to adopt a sustainable behaviour
 - Interesting implications for business strategy to exert incentives to reduce energy consumption
- Social acceptance of the needed transformation of societies also means to understand and considerer how to encourage and support behaviour change