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Mind the gap when implementing technologies intended to reduce or shift energy consumption

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Introduction

The DR-BOB project - Pilots

http://www.dr-bob.eu/

https://vimeo.com/176786849

DR-BOB is a H2020 EU-funded project which stands for *Demand Response in Blocks of Buildings*. The project started in March 2016 and seeks to integrate existing technologies to create a scalable solution that enables DR operations in buildings consisting of different blocks.

The DR-BOB solution has the potential to unleash the DR capabilities of Block of Buildings and enable both price-based and incentive-based DR operations

Technical University di Cluj Napoca - Romania

Teesside University – Middlesbrough (UK)

Poliambulanza Hospital – Brescia (IT)

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DR BoB and its user groups

Who are the users?

- Most obviously: the energy/facility/ building managers
- The building occupants: people who work, visit, recover, live in these BoBs but who
  - do not bear the cost of energy
  - have no direct role in decision-making

They tend to fall out of sight….

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Mind the gap!

The risk is that the designed solutions for Demand Response do not match with the daily practices and routines on the part of the building occupants.

Gap: between expected and actual performance of technologies intended to reduce or shift energy consumption

Such mismatches:

- disappointing performance
- disappointed end users.

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Mind the gap!

This problem was explored using the following concepts

- ‘design logic’: the picture of the intended user held by a designer
- ‘user logic’: related in this case to how users or building occupants currently live and work in a building

Successful design: reflects and understanding of the underlying logic of its intended users and has ‘written’ this into the functionally of their designs.

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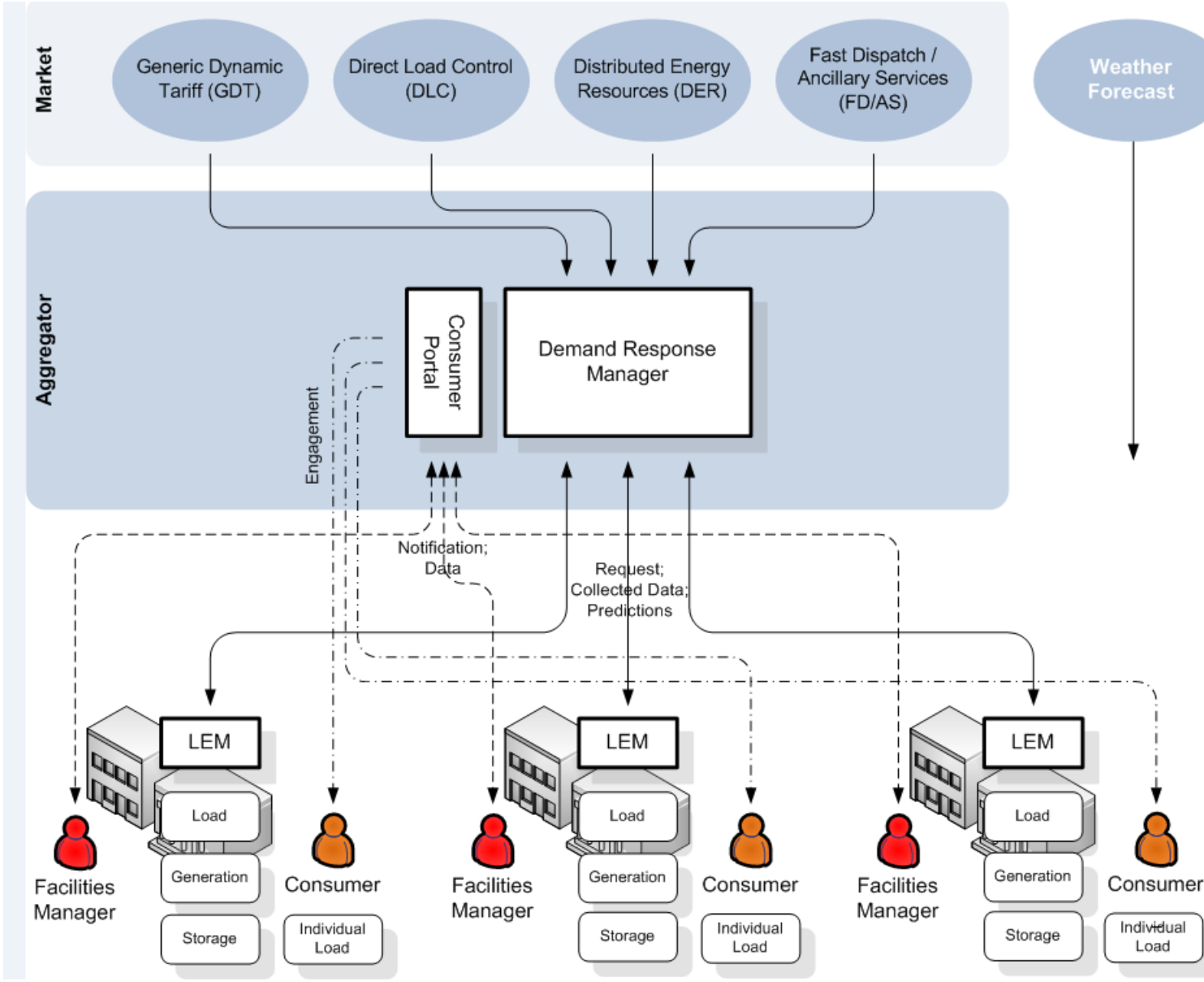
The DR BoB Solution: The Designers' Perspective

The DR-BoB energy management solution:

- A Demand Response Manager (DRM) provided by Siemens DEMS®
- A Local Energy Manager (LEM)
- A Consumer Portal

Together these tools provide an innovative scalable cloud based central energy management system for single and multiple blocks of buildings, which interacts with a buildings pre-existing systems and appliances, such as Building Management Systems (BMS), Heating, Ventilation, Air Conditioning (HVAC) systems, laboratory and office equipment, laptops, and lightning etc..



Crosbie, T., Short, M., Charlesworth, R., Broderick, J., and Dawood, M. (forthcoming) DEMAND RESPONSE TECHNOLOGY READINESS LEVELS FOR BLOCKS OF BUILDINGS, Sustainable Places 2017, June 27th -29th Teesside University, Middlesbrough UK

Demand Response Scenarios

The scripts of the DR BOB solution are made explicit in the demonstration scenarios:

- Each demo site has several scenarios
- All these scenarios reflect a design logic of the DR BOB project team
- Each scenario describes:
  - DR events that can occur
  - Formal responses to the DR events
  - Role of the direct users (building managers; facility managers)
  - Expected response on the part of the occupants (e.g. staff, students, teachers, technicians, visitors)

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Empirical material

Empirical material:

4 sites

3 to 5 demo-scenarios per site, written down in scenario descriptions

> 30 respondents have participated in interviews and/or workshops at each pilot site in 2016/7 (e.g. facility-, building- and energy managers, technical staff, as well as occupants and the pilot site managers)

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Scenarios and how they impact occupants:

~~0. No impact at all (when the source of energy is temporarily changed)~~

A. Occupants will hardly notice anything

B. Occupants (or some of them) are actively involved and asked to turn off or unplug appliances during peak hours

C. Occupants (or some of them) are actively involved and are asked to shift their activities to another moment

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Expectations about users in DR Scenarios

A. Occupants will hardly notice anything: set-point changes of heating and cooling installations are done by the building manager

Scenario:	Entails what actions?	Expectation about occupants
UK S1	The FM is asked to change set-points for heating and cooling to shift demand during the peak moment (opt out possible)	No impact on occupants expected because rooms are pre-heated or -cooled and temp is not allowed to move outside of the set band-widths.
FR S1; S2	BM is asked to change settings of various assets for cooling and heating (can opt out)	No impact on occupants expected because rooms are pre-heated or -cooled and temp is not allowed to move outside of the set band-widths.
ITA S1;	BM is asked to change settings of chillers (can opt out) (Overall the energy consumption may rise)	Lowering the temp of the cooling water may affect indoor temperature at the start
RO S1	EM asked to change settings manually (can opt out)	

Expectations about users in DR Scenarios

B. Occupants (or some of them) are actively involved: they are asked to manually turn off or unplug appliances during peak hours in case of a DR event.

Scenario	Entails what actions?	Expectation about occupants
UK S3a	Via FM, team leaders are asked to ask staff to do a more extensive shutdown of equipment (opt-out = not responding)	Occupants are expected to (really) turn off non-used equipment when receiving such a request from team leaders (manual adaptations and perhaps shifting activities)
FR S1; S2; S4	Occupants asked via mail to disconnect equipment (e.g. laptops) (opt-out is possible)	Occupants are expected to unplug equipment on batteries when receiving such a request (manual adaptations and perhaps shifting activities)
ITA S2	Occupants asked via mail to turn off unused equipment or disconnect laptops (opt-out is possible)	Occupants are expected to unplug or turn off equipment when receiving such a request (manual adaptations and perhaps shifting activities)
RO S1; S2	Occupants asked to manually shut down equipment and pre-cool their offices	Occupants are expected to unplug or turn off equipment when receiving such a request (manual adaptations and perhaps shifting activities)
RO S3	Demand reduction in student dormitories	Occupants are expected to unplug or turn off equipment when receiving such a request (manual adaptations and perhaps shifting activities)

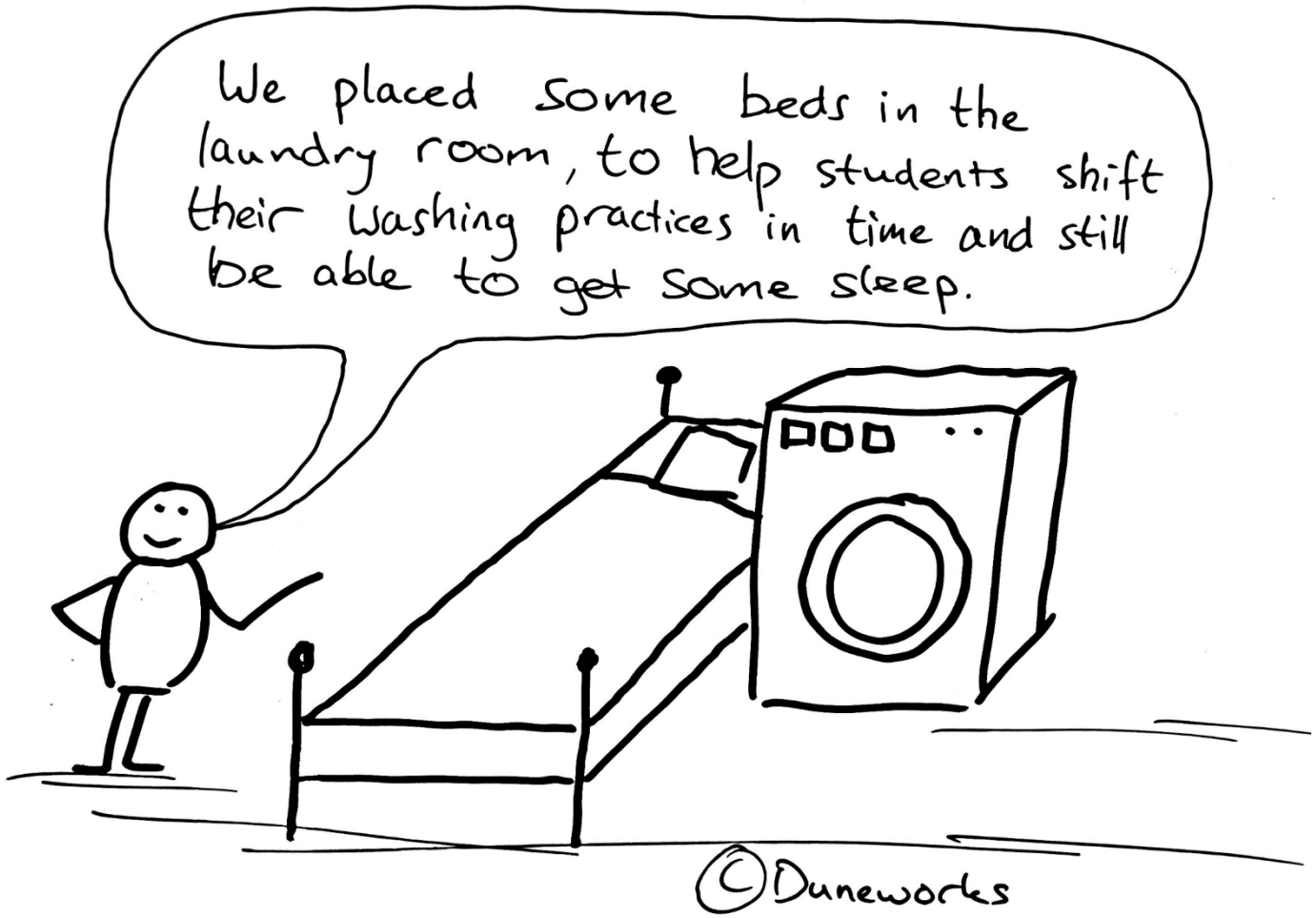
Expectations about users in DR Scenarios

C. Occupants (or some of them) are actively involved: in case of a DR event, they are asked to shift practices in time: e.g. to charge their Electrical Vehicle (UK) on a different moment; to shift use of washing machines in student dorms (RU); to shift cooking schedules (IT)

Scenario	Entails what actions?	Expectation about occupants
UK S3B	Request to EV users via de FM to not charge the car (opt-out = not responding)	Expectation that in future this may provide DR potential (currently not many EV users)
ITA S3	Request to change the use of cooking equipment outside peak hours	Expectation that canteen staff can and is willing to do this
RU S2	Changed washing schedules	Expectations that students are flexible and are able to wash their clothes outside peak hours

Design logic in the scenarios	Use logic based of occupants
Changing the set points: occupants won't notice because we make sure that temperature changes do not exceed certain thresholds. Occupants are probably willing to accept certain changes in set points	What if the current indoor climate is considered unsatisfactory, how will that affect occupants willingness to accept further changes?
Why inform them if they probably won't notice any changes?	What if occupants find out or if something goes wrong, and how will that affect trust in the organisation?
Occupants will turn off non-used equipment when asked, unplug battery-based equipment, pre-cool their rooms when they are asked to do so	Why would they do that? What is in it for them? (undermines comfort and convenience; doing noth is easier)
Emails will be sent to building occupants	Why would they read these and/or pay real attent to them?
Occupants will shift some practices to other moments of the day on an irregular basis	Why would occupants be willing to take that effor voluntarily? What is in it for them?

Concluding on gaps and mismatches



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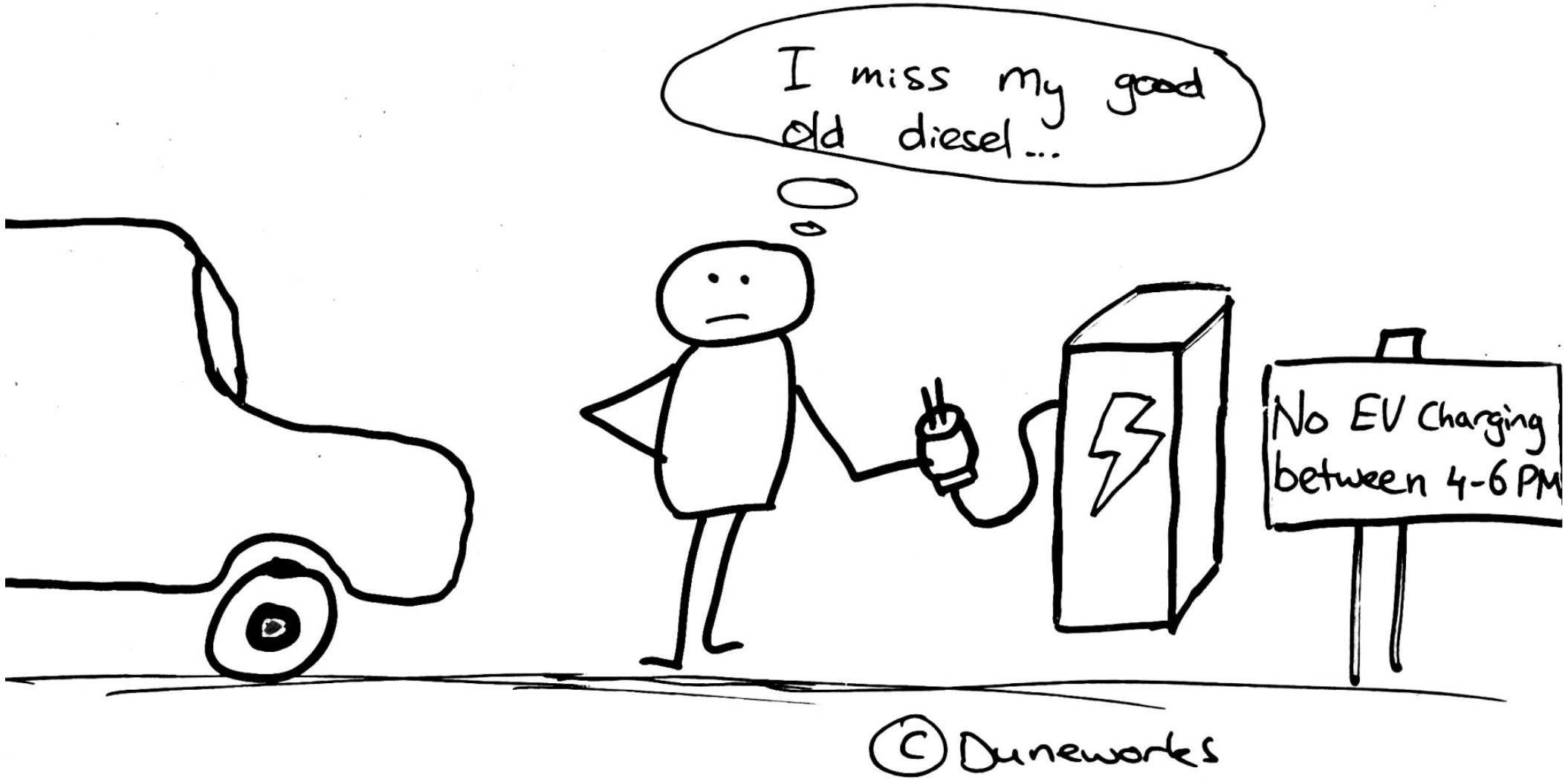
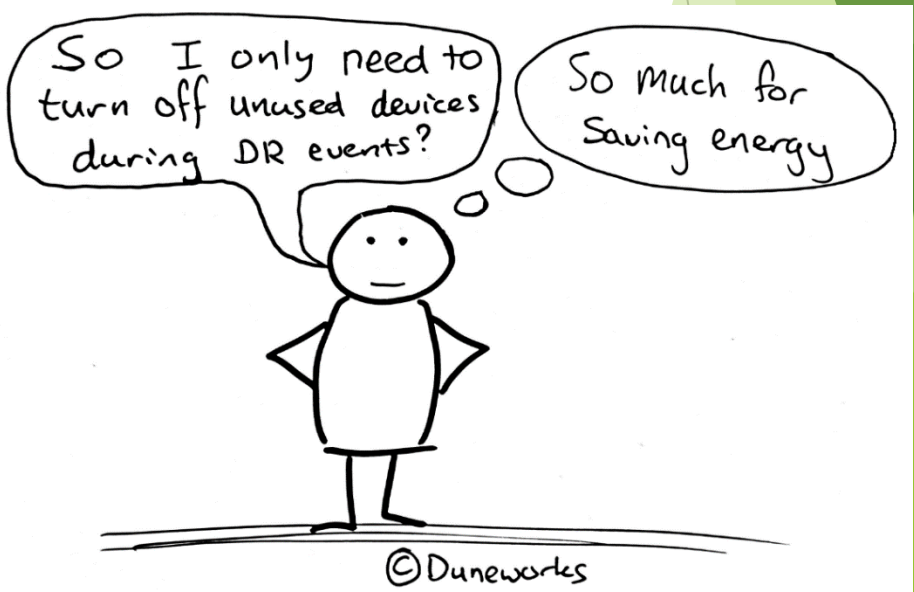


Concluding on gaps and mismatches

The design logic from the DR solution provider does not necessarily match with the building occupant's logic. Mismatches easily occur:

- Current levels of satisfaction among the occupants
- Quality of devices that occupants are asked to unplug
- What's in it for the building occupant?
- Communicating DR events: getting noticed
- The message: how to connect to peoples' motivations



Recommendations

1. Learn about occupants current perceived comfort levels
2. involve or at least inform occupants about the DR programme
3. Active engagement needs more than information provision
5. Learn what motivates building occupants
6. Learn form energy saving interventions in offices elsewhere
7. Occupants themselves are best able to tell what works for them or not

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Flipping the perspective: taking the occupant (the final end-user) as point of departure

Risk: that the indirect users become to be regarded as a barrier when they do not behave as they are intended to – while in fact it is the design that does not match

Flipping the perspective:

Taking it one step further would mean that DR becomes part of a path of improving the quality of the places where people work, gather, learn, and recover, so that this quality for these people remains central.

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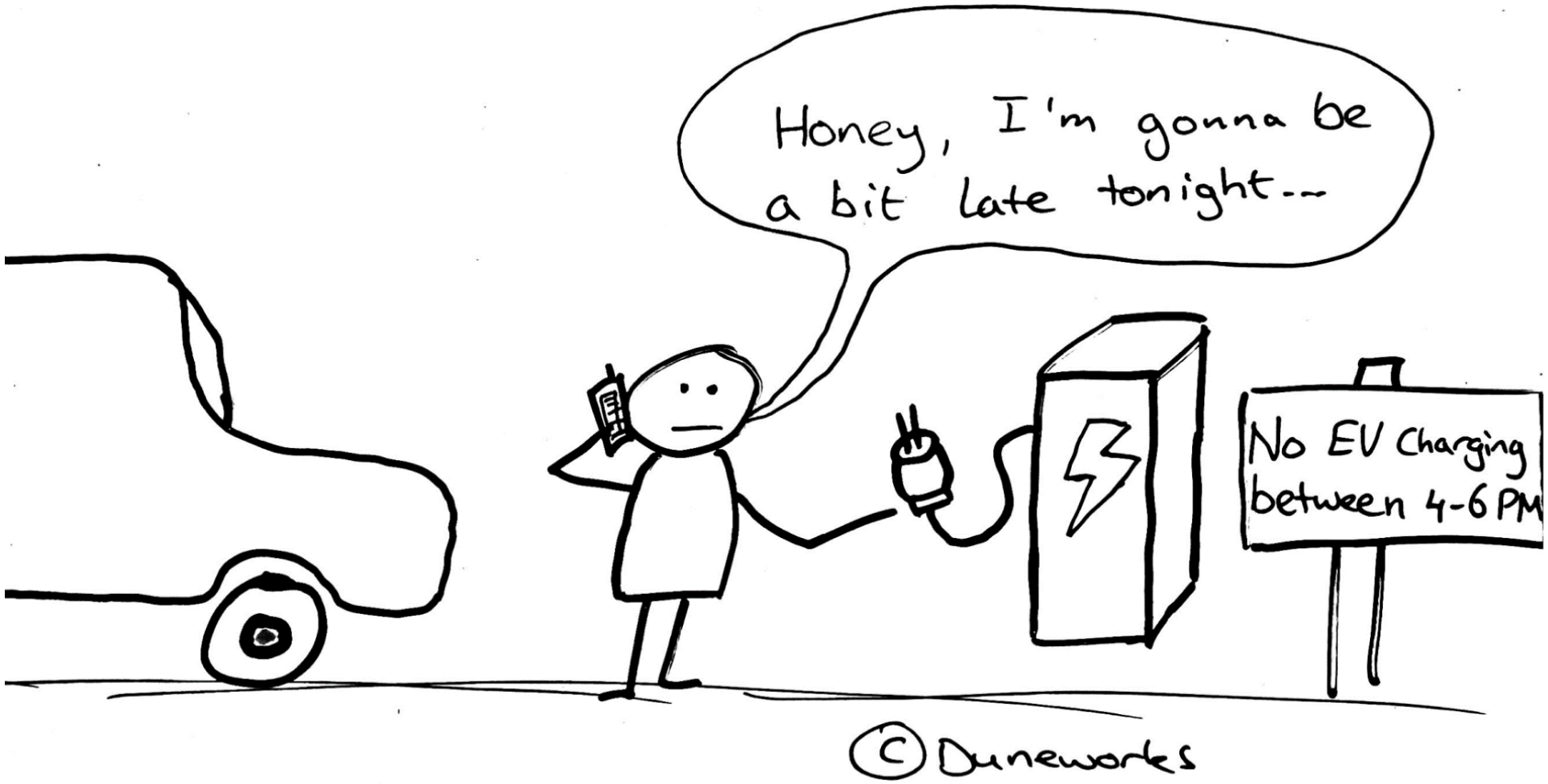

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