Smart Grids, Information Flows, and Emerging Energy Practices

November 2nd 2015

The Dutch Experience and Implications for China

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For quality of life

Presentation at *"The First Asian Energy Conference: Smart Grids, Sustainability Transition, and Innovation in Governance"*, Hong Kong

Contents

= 20 minutes

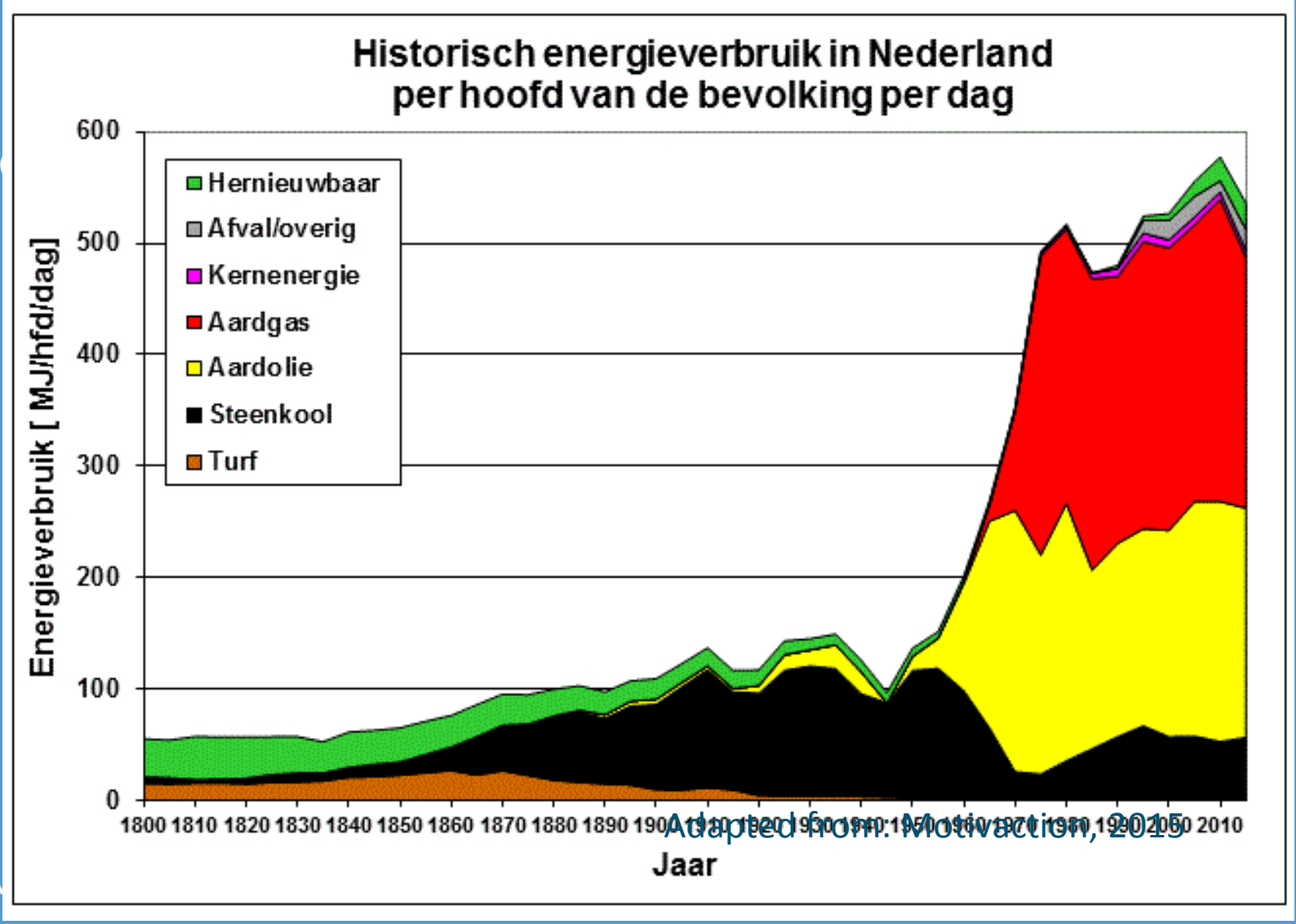
1a. The Dutch context

- From gas to electricity

Adapted from: Motivaction, 2015

1a. The Dutch context

- Fr



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1a. The Dutch context

- From gas to electricity
- Renewable energy: behind but accellerating

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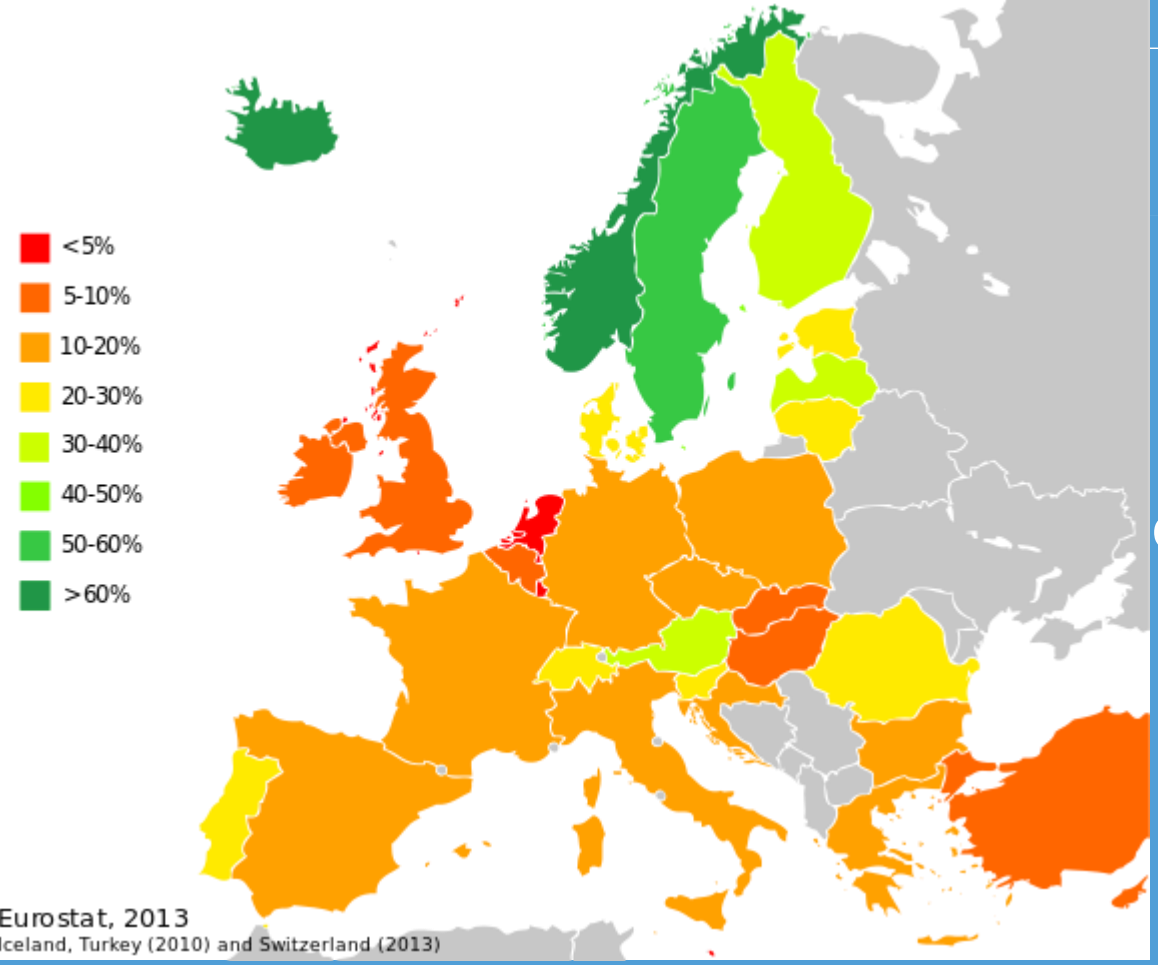

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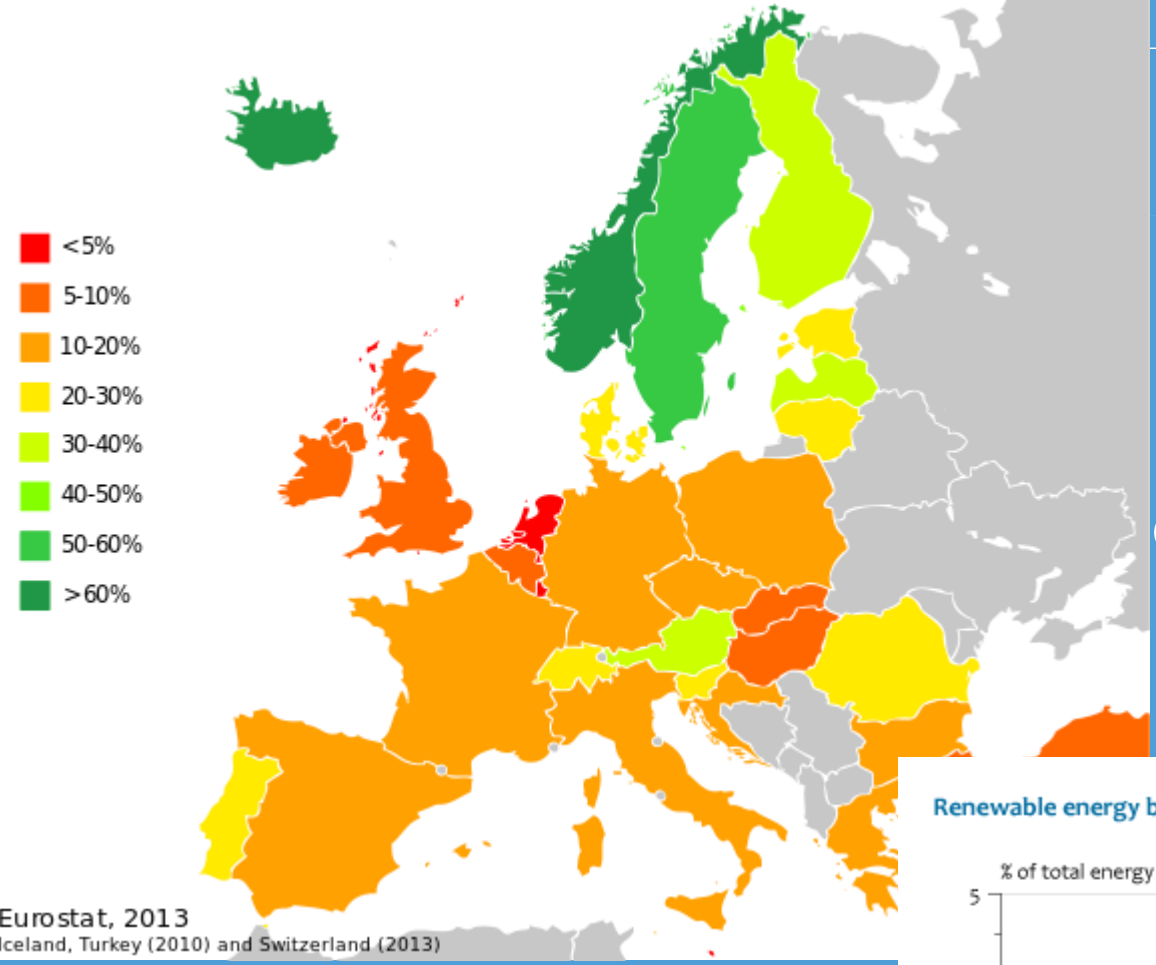

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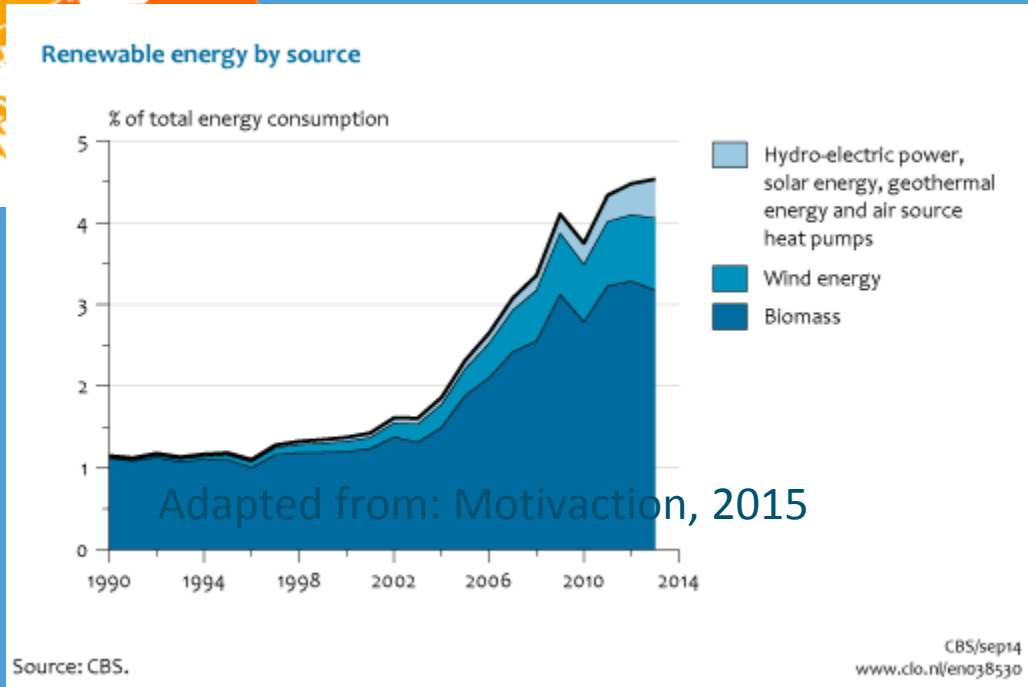

Adapted from: Motivaction, 2015

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1a. The Dutch context

- From gas to electricity
- Renewable energy: behind but accellerating
- 400-500 energy cooperatives or initiatives
- Dutch households & energy: segmented

Adapted from: Motivaction, 2015

1a. The Dutch context

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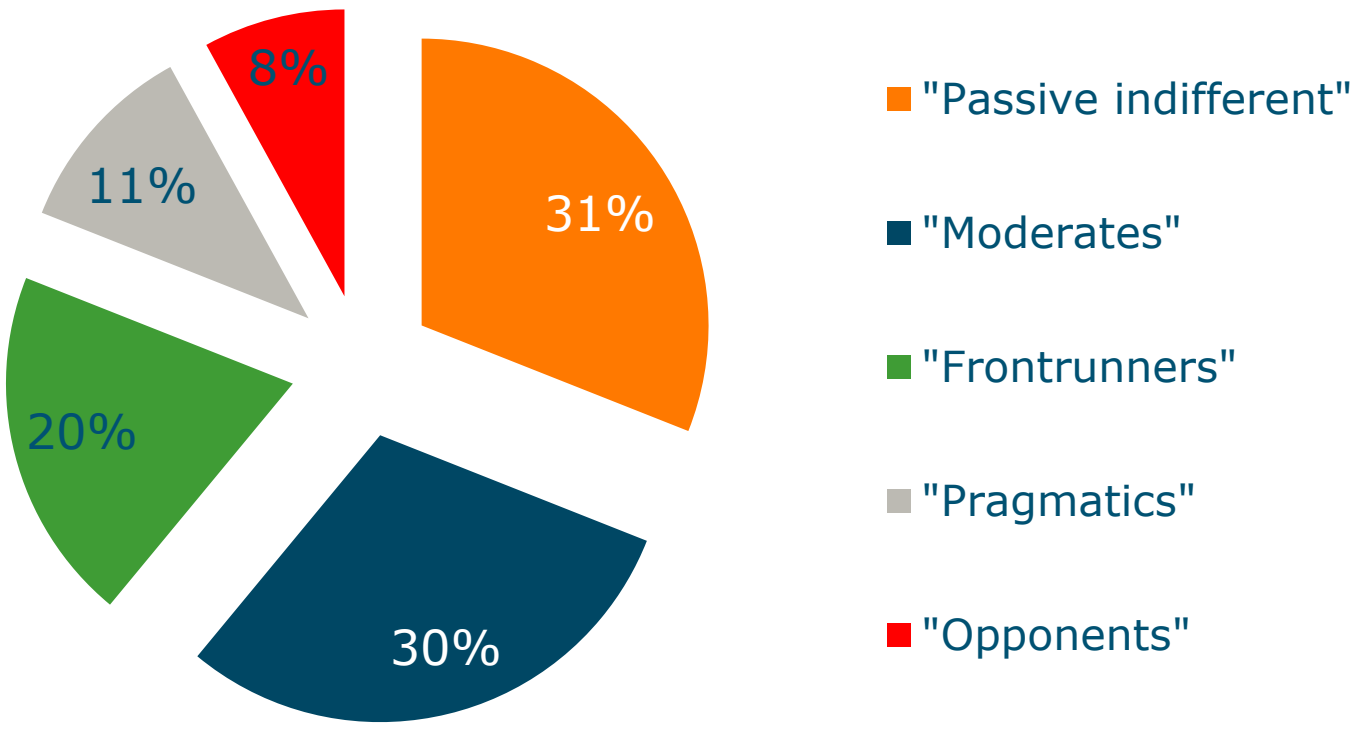
Segmentation of Dutch householders 'acceptance of energy innovations'



Adapted from: Motivaction, 2015

1b. The smart grid in Dutch perspective

- State of affairs:
  - TNO report: **flexibility** is economic value
    - The search is on: business, consumers?
  - Smart meter roll-out underway (x%)
  - Smart grid pilot projects run by DSOs

INTRODUCTION TO THE FLEXIBILITY CHALLENGE

entsoe

Reliable Sustainable Connected

Florence Forum
Day One, 08 October
High level conference on a new energy market design

Since generation must balance demand at every second, generation must be able to follow the load variations (or the load must be able to adapt to generation constraints). This ability of the system to cope with fast variations in demand and/or generation is the system flexibility. The load curve to be served by dispatchable thermal and main hydro generators is the residual load (**RL**), which is the actual load (**L**) minus production of wind (**W**), solar (**S**) and **must-run** generation.

The ENTSO-E Scenario Outlook & Adequacy Forecast (SO&AF) 2015 report provides for the first time

- The search is on: b
- Smart meter roll-out und

NAAR EEN TOEKOMST-BESTENDIG ENERGIE-SYSTEEM VOOR NEDERLAND

FLEXIBILITEIT MET WAARDE

MANAGEMENTSAMENVATTING

TNO innovation for life

TNO.NL/ENERGIE

Energie+ productie

Wat is flexibiliteit waard?

De elektriciteitsvoorziening verkeert in een overgangssituatie. Fossiele energie wordt vervangen door duurzame energie, planbare productie door onstuurbare installaties, grootschalig door kleinschalig en kleinverbruikers worden actief in plaats van louter passief. Dit zijn ingrijpende veranderingen. De relaties tussen de partijen moeten herzien worden om tot een nieuwe evenwichtige en efficiënte energievoorziening te komen. Voor een duurzame energievoorziening is flexibiliteit noodzakelijk en er zijn mogelijkheden om dit te stimuleren.

1c. Smart grid pilot projects: three examples

LochemEnergie

2013-2016

Balancing supply and demand locally (tech. + behaviour)

Samen Slim met Energie

2014-2016

Engage consumers in grid management activities via energy cooperative (as **intermediary**)

Jouw Energie Moment

2013- ...

Peak shaving through **time shifting**, testing **incentives** & effect

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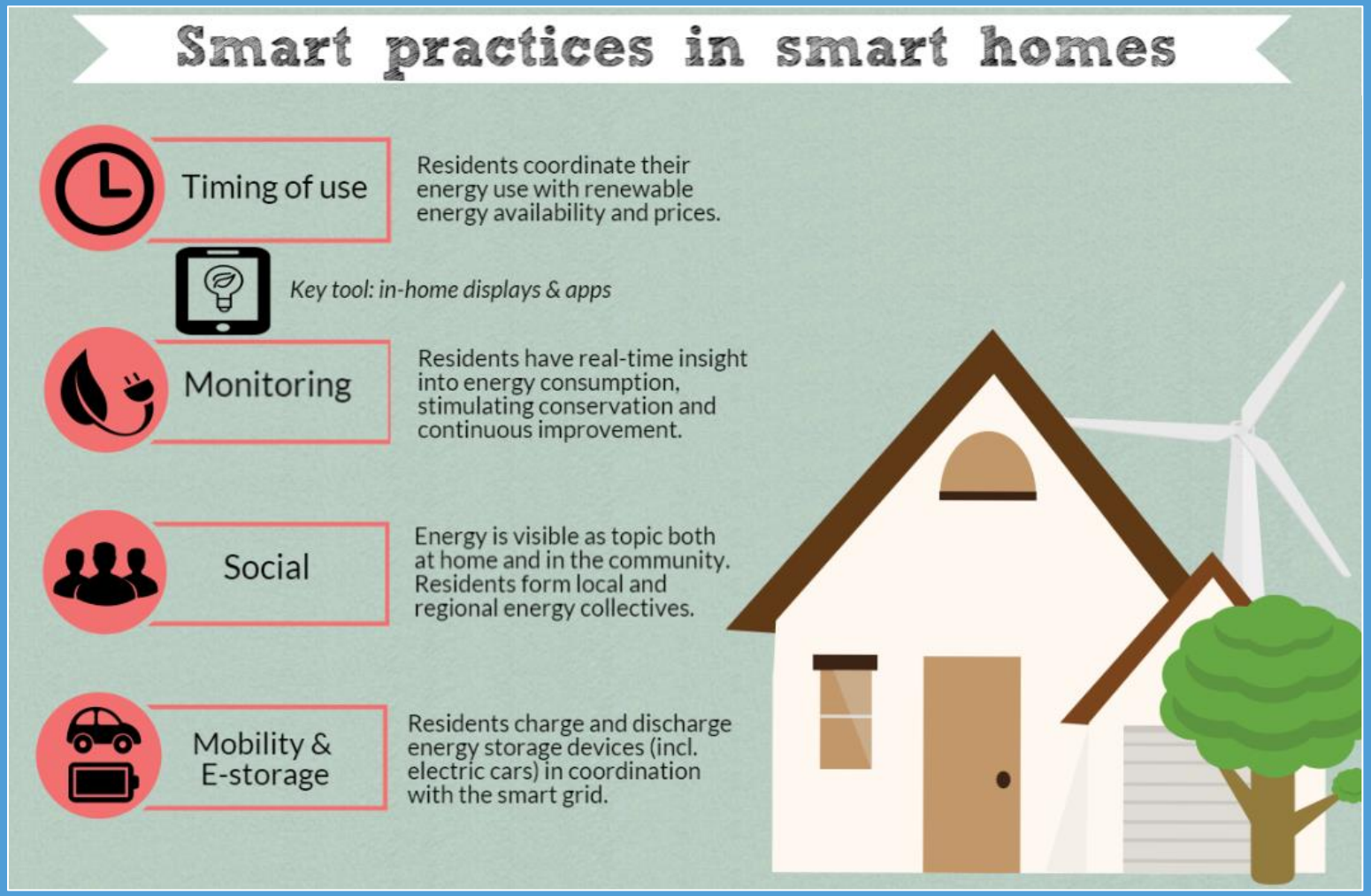
2a. ENP's perspective on smart grids

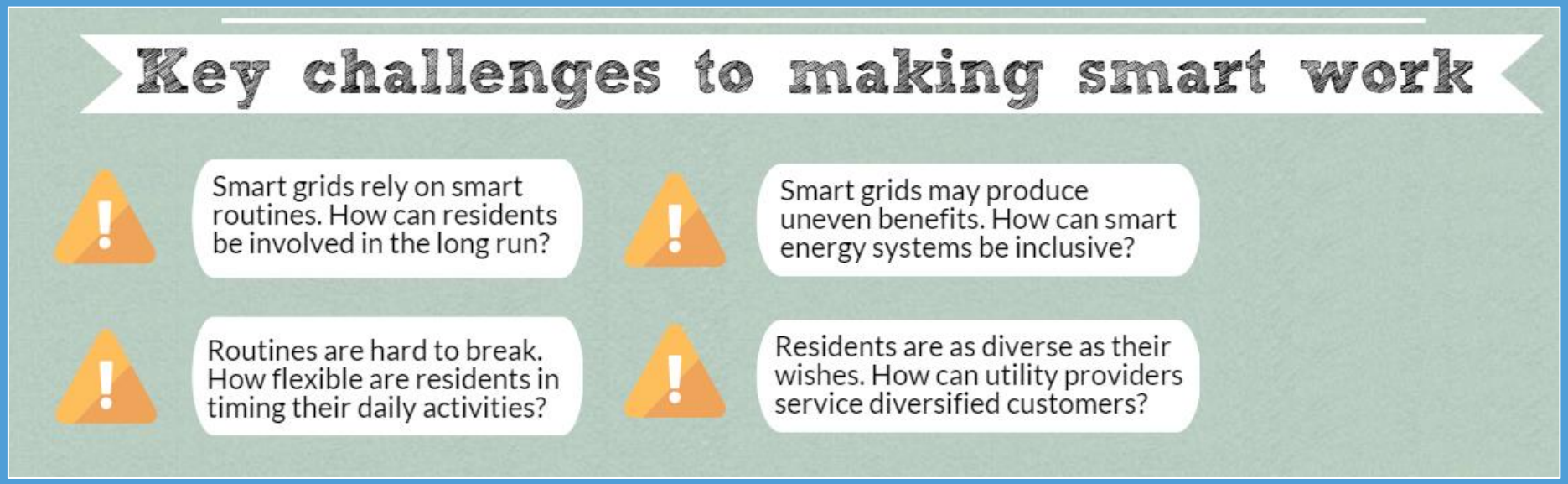
- Smart grids are not just technical systems. They:
  - (Re)organize consumer-utility relations
  - Challenge established energy behaviours
  - Offer new ways to promote sustainable consumption

- People don't consume energy: they use energy to perform daily activities
- Energy consumption is: routinized, contextual, situated, (often) non-rational behaviour
- Practice theory → *energy practices*

2b. Smart energy practices

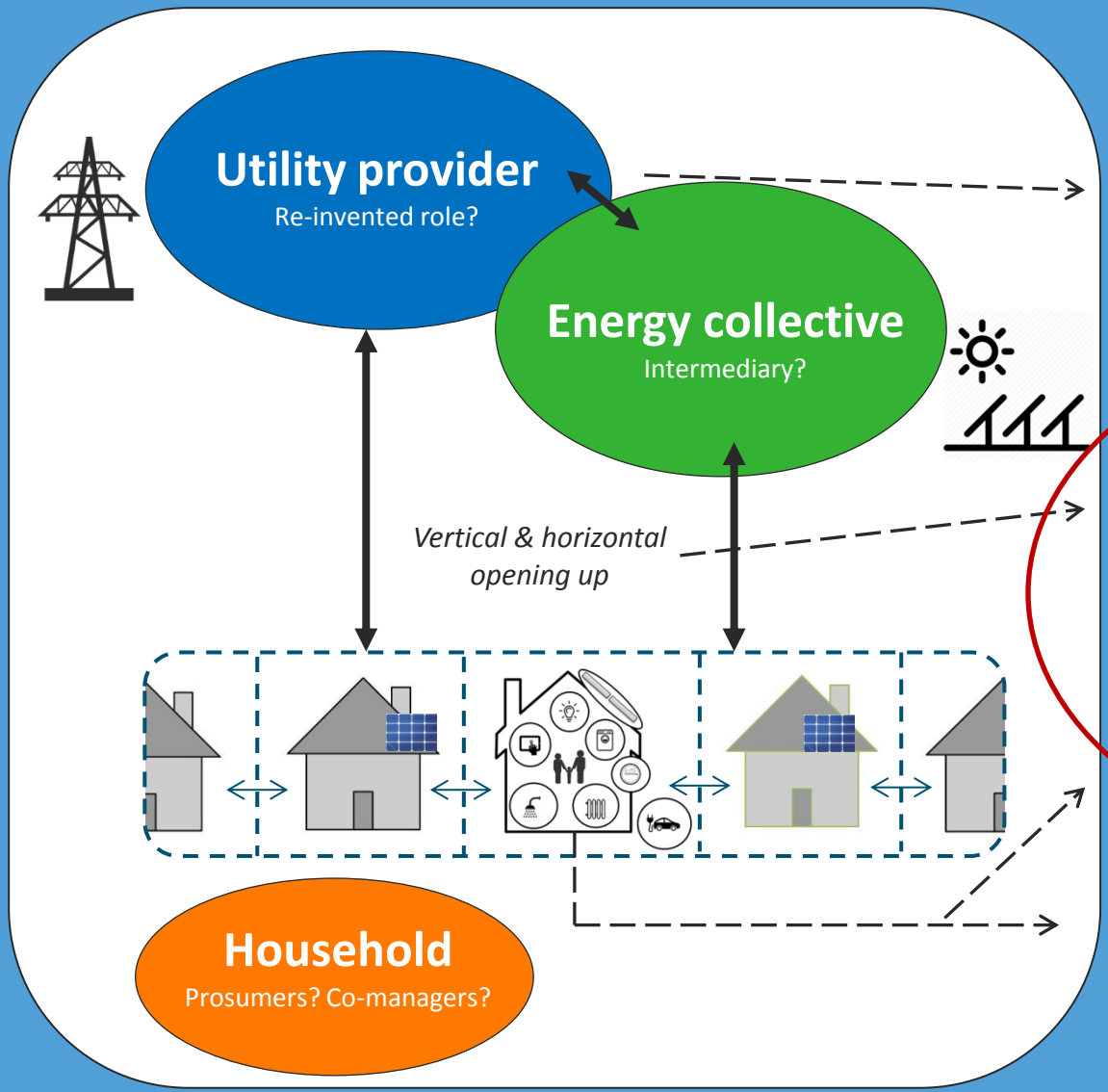


2c. 'Social' challenges



- More challenges:
  - What role could and should energy cooperatives play in smart energy systems?
  - How should the smart grid be designed so that it empowers households, not controls & disciplines?
  - ...

3. ENP's smart grid research agenda



Principle investigator:
Prof. Gert Spaargaren

Dr. Bas van Vliet
- Organization
- Intermediation
- (all of us)

Joeri Naus
- Information flows
- Privacy & autonomy
- Participation

Robin Smale
- Flexibility
- Daily life
- Cultural aspects

Nick Verkade
- Smart technologies
- Emerging practices

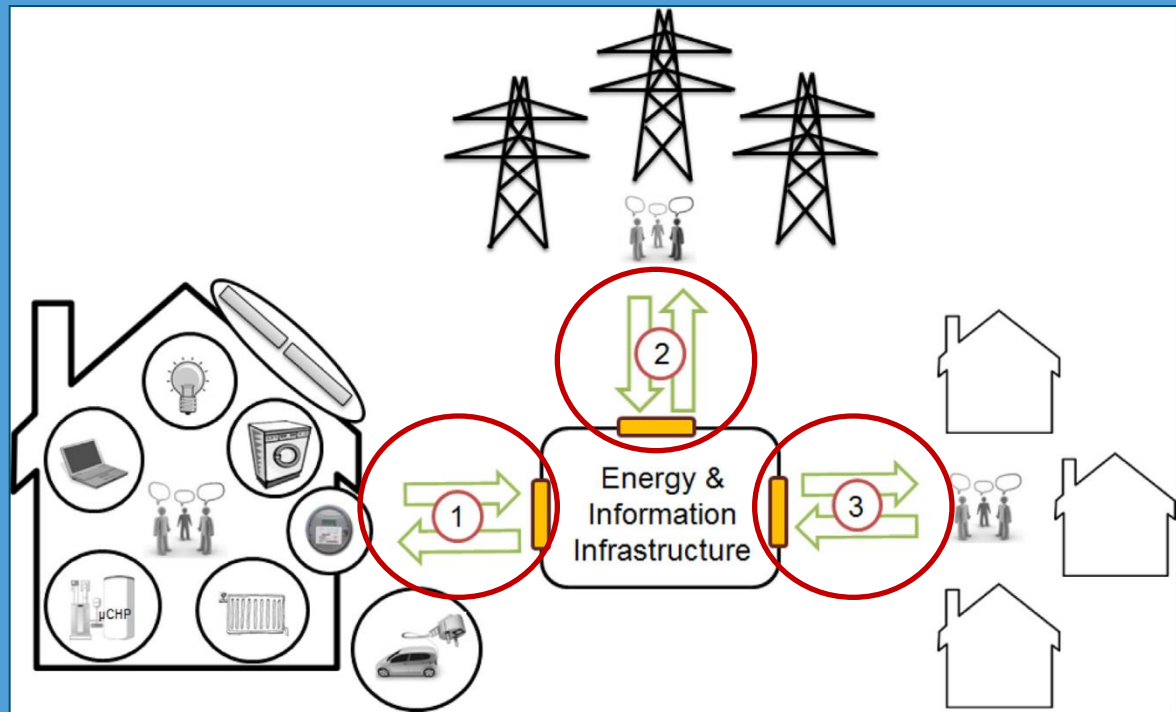
4a. Information flows

Naus et al. (2014)

- Three (new) information flows:
  1. Between household-members
  2. Between household & DSO
  3. Between local & distant households

➢ Changes in energy practices

➢ Changes in social relations



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4b. Householder participation

Naus et al. (2015)

- Participation involves a vertical (HH-DSO) and horizontal (between HHs) opening up of the household
- Householder participation in the form of: *energy monitoring*, *renewable energy generation*, and *time shifting*
    - How to organize?

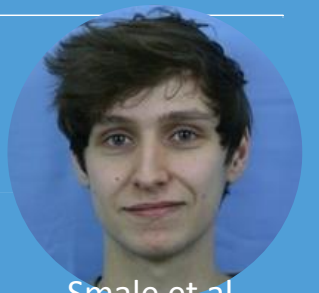
Energy management practices	**Private**	**Horizontal** (with fellow-householders)	**Vertical** (with service providers)
Energy monitoring	Self-monitoring	Information sharing	Feedback & advice
Renewable energy production	Domestic production	Collective production	Large-scale production
Time-shifing of energy use	Domestic time-shifting	Communal time-shifting	Demand control

4c. Householder participation

Naus et al. (2015)

- Households **support both horizontal** and **vertical** cooperation, but run into privacy & autonomy issues impeding participation
  - Peer pressure, surveillance, conflicts
  - Local energy collectives are a middle ground
  - Desire to cooperate with 'green' service providers
- **Decentralized systems** promising because they enable *bundling* of energy management practices and *renegotiation* of horizontal-vertical relationships...
  - ...which empowers households with more control - while also opening up to all new forms of control

5a. Cultural perspective

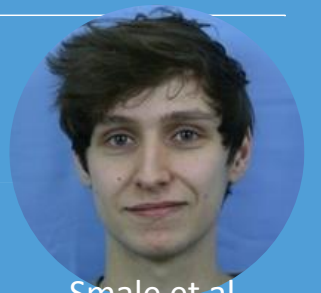


Smale et al.
(work in progress)

- Cultural & moral perspective on smart grids
- **Moral economy** approach
  - Households consume energy in the way they believe is the right way
  - Good and bad practices
  - Households make implicit and explicit agreements on 'the way we do things at home'
  - Practices also have moral imperatives
  - E.g. laundry demands regularity; showering is about comfort as much as getting clean

How does this *clash* or *align* with the (implicit) cultural mores of Smart Energy Systems?

5b. Cultural energy flexibility



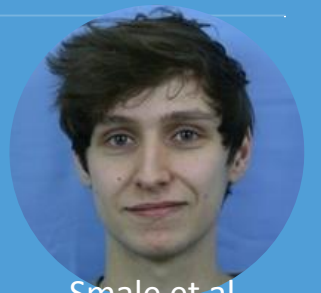
Smale et al.
(work in progress)

- *Flexibility profile* of Dutch households
- Clustering of domestic energy practices on cultural mores:

Cluster of practices	Cultural mores	Estimated % of total electricity use*
Lighting & heating spaces	• Frugality and care • Elastic demand if strictly no loss of comfort • Inflexible daily & seasonal rhythm **Automation?** **'Flexibility contracts'?**	**~20%- …**
Leisure & cooking/eating	• Control is important • Indulgence permitted • Make up the 'coldspots' of the day **?**	**~30%**
Domestic cleaning practices	• Certain frequency, care, and frugality • Weekly rhythm, planning involved • Flexible/elastic demand **Later, E-mobility**	**~20%**

*Source: Energietrends 2014 (Dutch households)

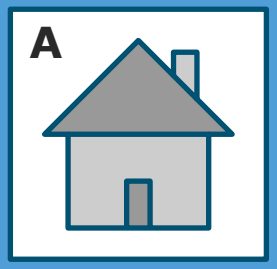
5c. Differentiating households



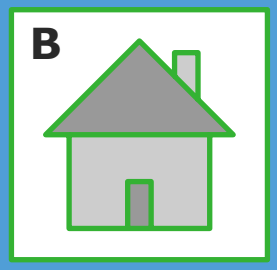
Smale et al.
(work in progress)

- Energy morality of the Western household?
  Three ideal types:
  - Type A: economy and comfort centred
  - Type B: sustainability centred
  - Type C: autonomy centred

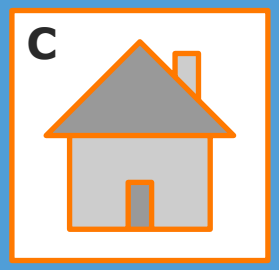
-
Investment & engagement
+



- Energy (preferred) invisible
- Affordable & reliable service

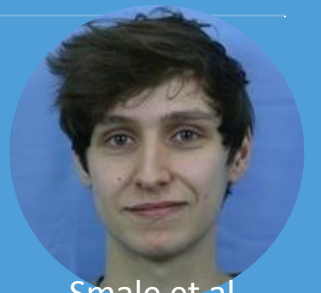


- Environmentally aware
- Willing to pay for green energy (service)
- Occasional investments in energy value



- Independent from grid
- High tech & low tech
- Is smart grid the new off-grid?

5d. The culture of the Smart grid?



Smale et al.
(work in progress)

- New teleo-affective structure (goals): from conservation + more renewable energy to **balancing** supply & demand
  - Accompanied by shift in reward system
  - Favours households with energy literacy and capacity to act
- Brings **rhythm** back in (dynamic pricing)
  - Is that progress? Subject to dispute
  - Planning around energy: a new chore for the poor?
  - Clash with progressive energy taxation?
- Energy: from service to resource w/ collective responsibility

6. Energy collectives in smart grids?

- Collective renewable energy generation + collective consumption!
  - Horizontal platform for effective flexibility?
- Proper incentive structure needed to organize collective demand time shifting; requires a 'contract' between:

  DSO ⟷ *energy collective* ⟷ *households*
- New mix of vertical and horizontal organization
- Energy collectives as DSO business partners? Goal alignment
  - Diverse goals, organization structure, commitment
- Successful? Too early to tell. Partner in testing new system.

7a. Conclusion: The Dutch experience so far?

- After lively privacy debate, now public investment in smart grid via DSOs
- Accelleration of smart applications entering market
- DSM peak shaving potential is currently insignificant, but promising in the future
- DSOs are developing business models and seeking alignment with (organized) consumer wishes
    - Pilot projects

7b. Conclusion: research findings

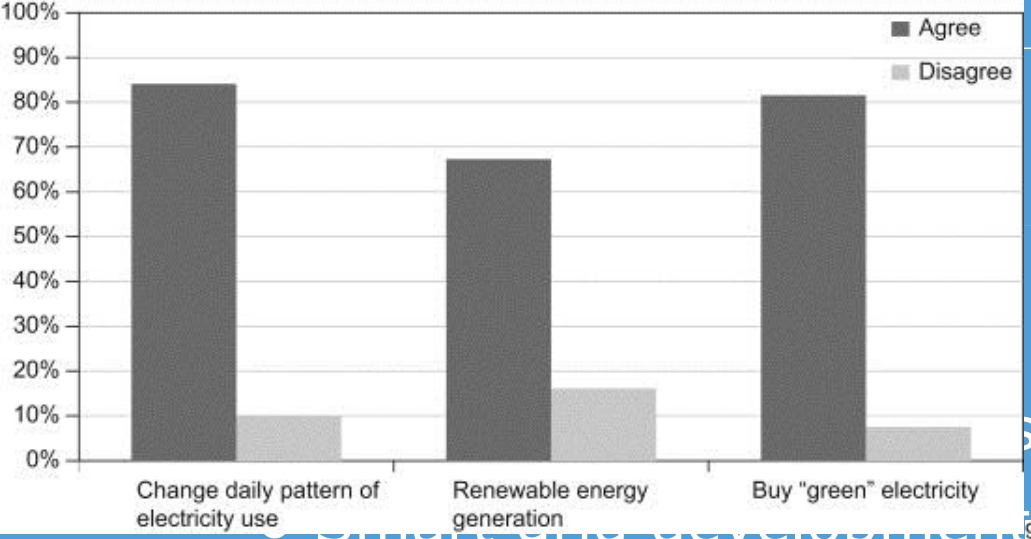
- Take home messages:
- New information flows open up the household to new forms of horizontal & vertical organization and participation
- Energy management practices challenge privacy & autonomy
- Smart grids have cultural implications too: examine interaction
- Timing of use & flexibility: established practices and rhythms are both opportunities and barriers (three clusters)
- Different households, different participation & business models
- Energy collectives: potentially valuable intermediary in smart grid transition

8a. Implications for China

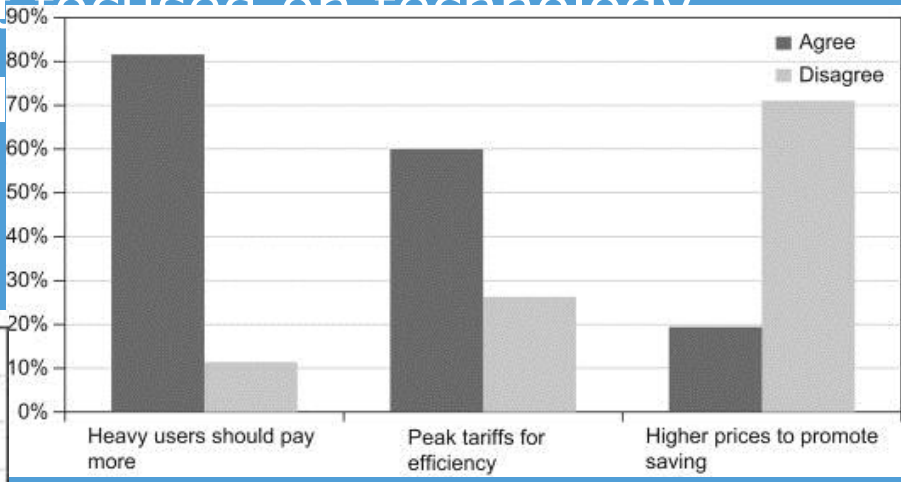
- State of affairs in consumer-side of smart grids in China:
  - Smart grid development focused on technology
  - "Smart grids are not only a technical innovation, but also an institutional innovation"
  - 'Customer participation needs developed e-market'
  - Regulation is mostly oriented at **low-cost and extensive servicing (mismatch?)**
  - Call for pilot projects on increasing acceptance
  - Show-case pilot projects

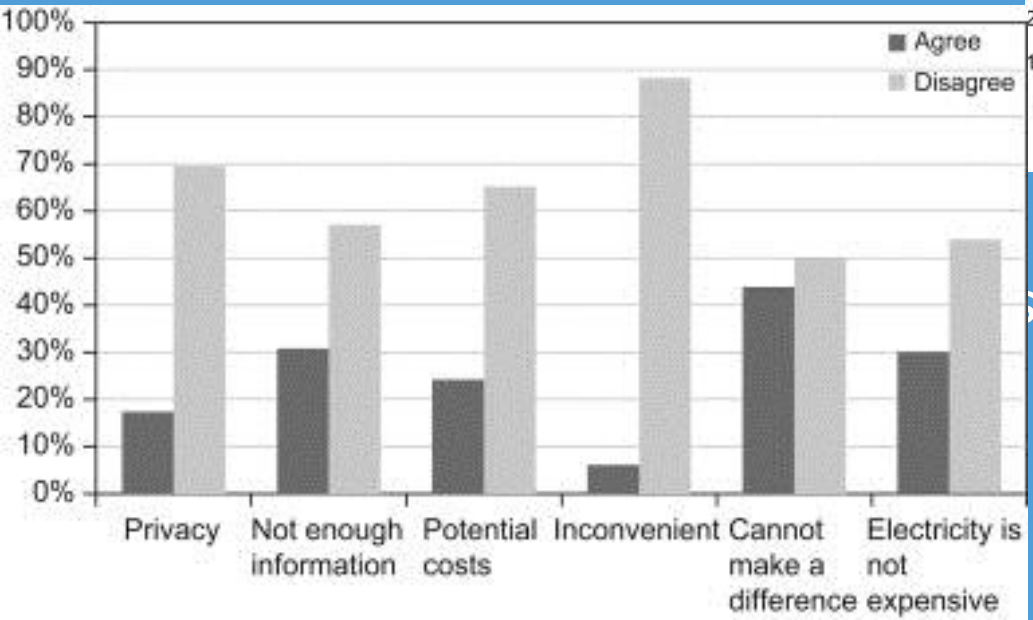
Yuan et al., 2014

Yu, Yang, Chen (2012)



- "Smart grids are not onl
  but also an institutional
- 'Customer participation





increasing acceptance

Yuan et al., 2014

Yu, Yang, Chen (2012)

8b. Implications for China

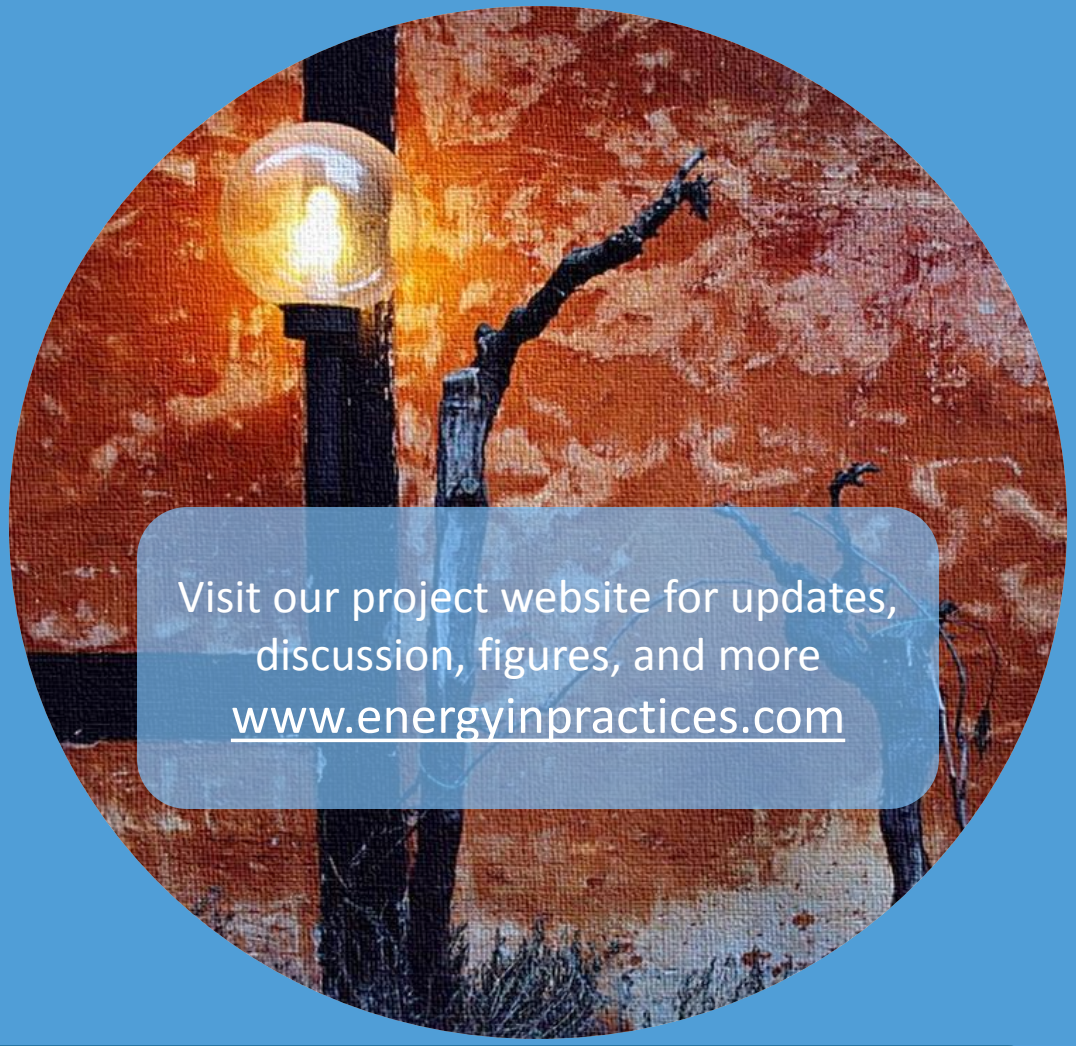
- Household participation (acceptance =/= participation):
  - Organizing smart energy management practices in China: horizontally, vertically, privately?
  - How to channel householder participation in smart grids?
    - Absense of energy collectives
    - Other intermediaries? E.g. housing coops
    - Renewable energy generation is centralized (absent motivator)
  - Household participation requires (financial) incentives, which in turn needs mature, liberalized energy market …

8c. Implications for China

- Demand Side Flexibility:
  - Potential contribution of households to peak shaving?
  - Need to investigate established energy practices, to assess flexibility potential
  - Need to investigate: who benefits from rewarding new rhythm?
  - Dynamic pricing:
    - Interaction with plan for (progressive) residential electricity price ladder program (Nov 2011)
    - Cheap energy a cornerstone of Chinese development
  - Flexibility through DSM is political: whose responsibility?
    - Utilities: public actors embracing governance?

Thank you

Are there any questions?



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