

April, 15 2021

Beneficial electrification – Sector integration

China's Electric Power Sector Transformation, webinar 2
IEA, EPPEI, DEA

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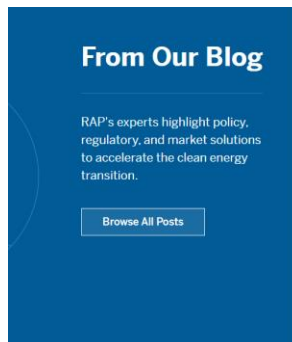
About RAP 睿博能源智库

The Regulatory Assistance Project (RAP)[®] is an independent, non-partisan, non-governmental organization dedicated to accelerating the transition to a clean, reliable, and efficient energy future.

Learn more about our work at raponline.org

RAP work in China

- Energy revolution and power sector reform, September 2020
- Electrification and Power Sector Reform: Coordinating Dual Challenges, March 2020



March 25, 2021

零售电价改革：浅谈中国当前面临的挑战及解决方案

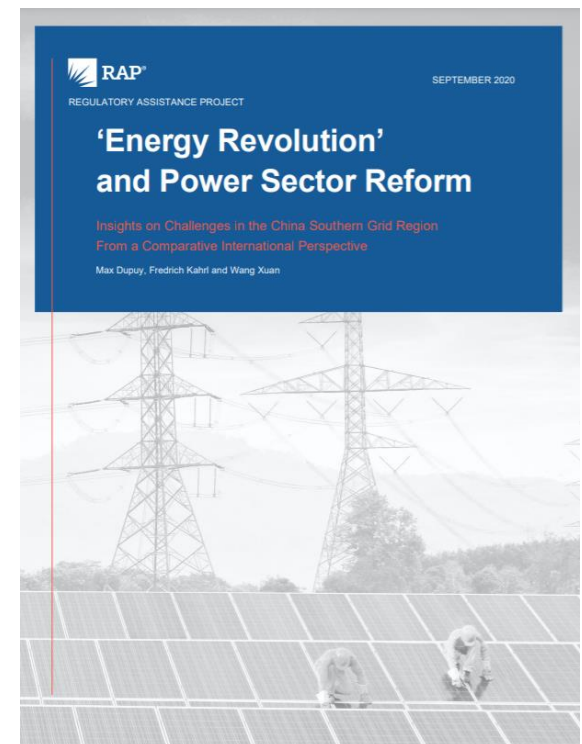
近年来，中国以及世界各国的电力系统正在发生着根深蒂固的变化。在供应侧，大规模可再生能源并网需要有更灵活的运行机制，在需求侧，新兴的发电技术和应用包括可再生能源分布式发电、电动汽车、储能和电气化改变了传统的集中式发电模式。此外，能源通讯系统... By Wang Xuan, Max Dupuy, Friedrich (Fritz) Kahl



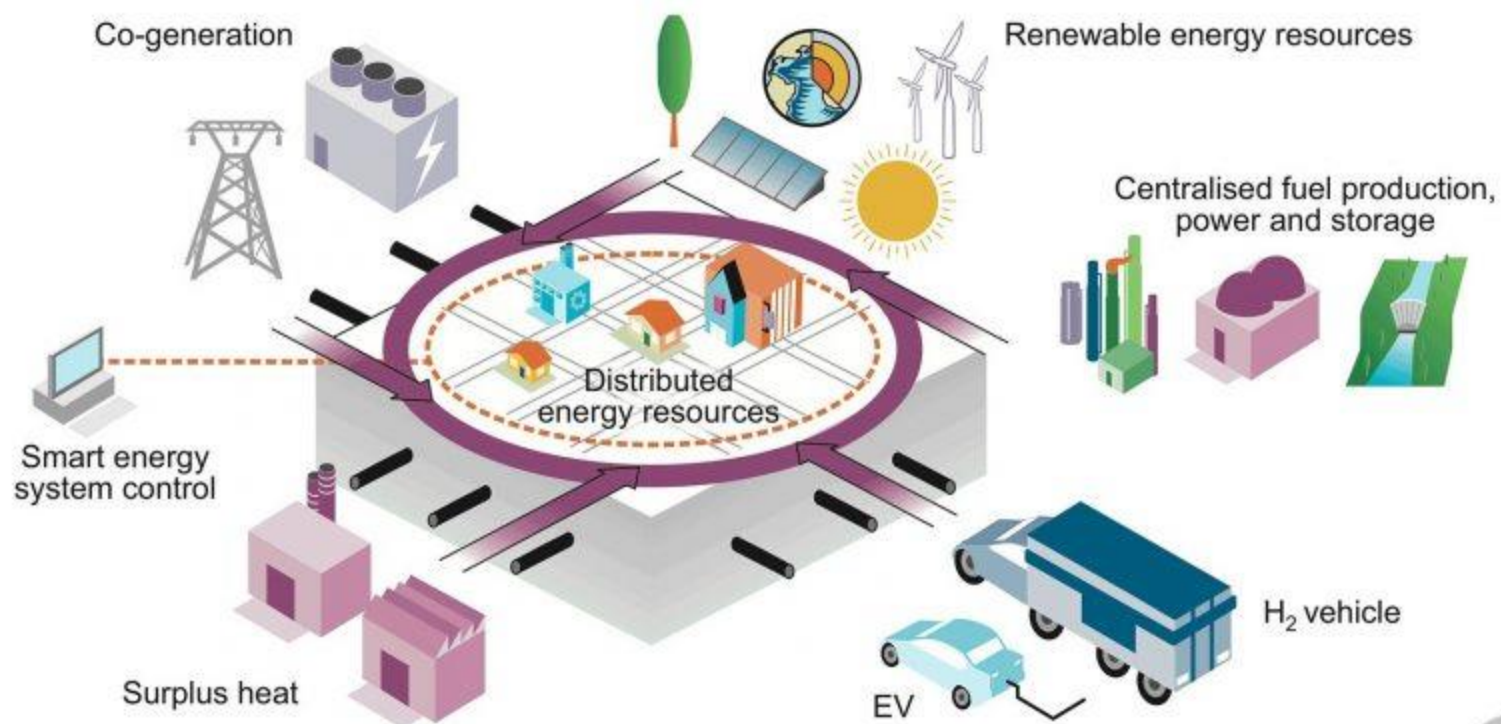
March 3, 2021

对美国得克萨斯州能源危机的一些初步想法

德州能源危机引起了美国以及世界各国媒体的广泛关注。在中国，有关德州事件与中国电改相关性的讨论也正在进行。德州政府和相关专家现在正处于调查分析危机的早期阶段，距离所有相关事实公开还需要一段时间。也许现在给出完全确定的结论还为时尚早，但可以从德州... By Max Dupuy



Sector coupling



Dual challenge of power sector reforms

- Reduce emissions
 - Change evolution of electricity generation mix
 - Rational market design and implementation
 - Improved power sector planning
 - Well-enforced environmental regulations
- Control cost electrification & support integration of renewable energy
 - Unlock **flexibility** of electrified end uses

Beneficial Electrification - Unlocking the flexibility of electrified end-uses



1. Save Customers Money Over Long-Term



2. Reduce Environmental Impacts

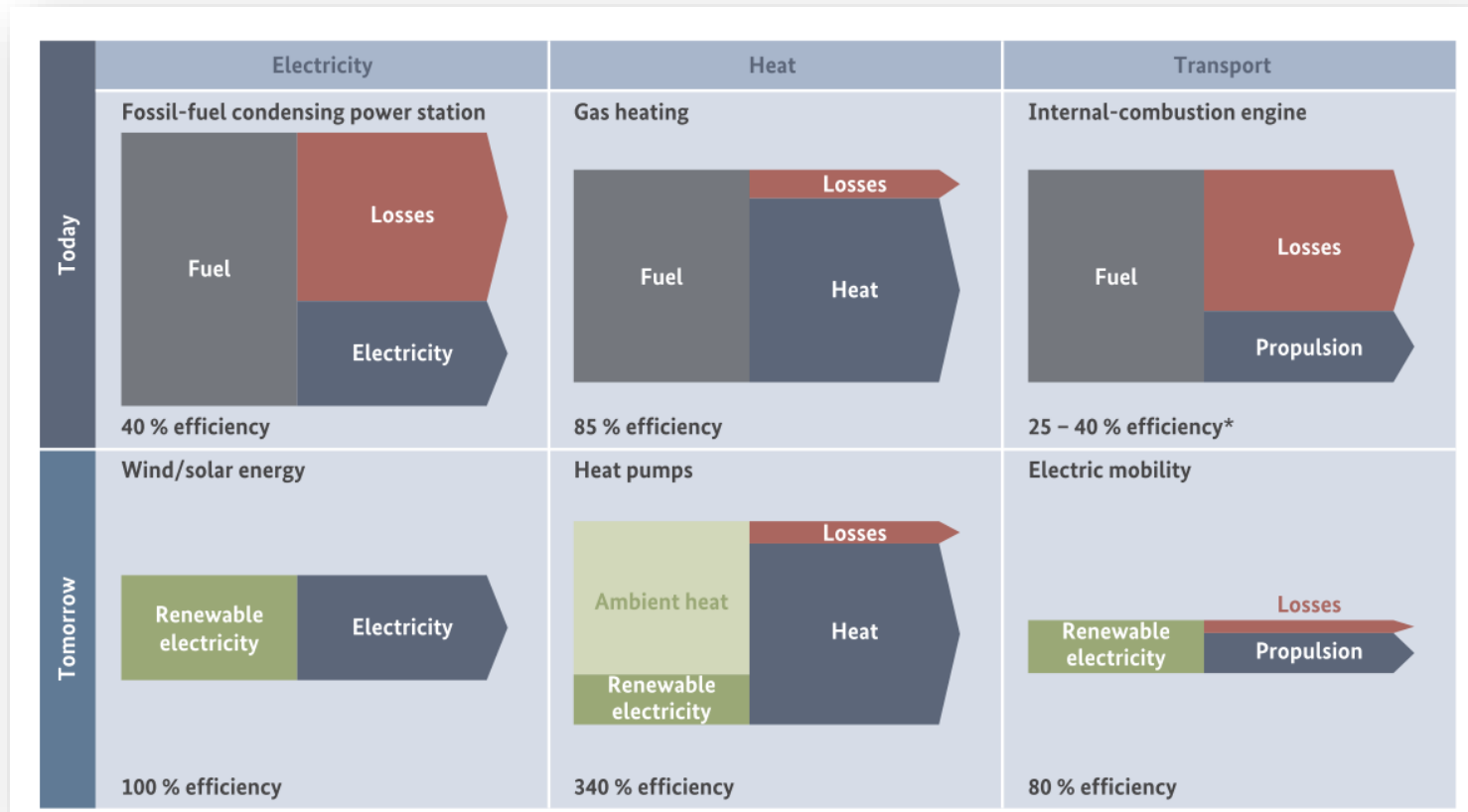


3. Enable Better Grid Management



1. Save Customers Money Long-Term

Efficiency Across Fuel Types



Source: Brown et al., Response to burden of proof, 2018

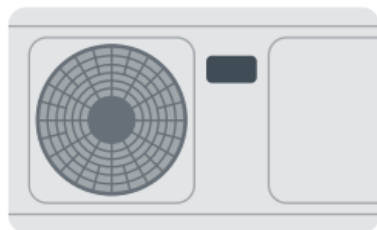
In 2050, it will be **55% cheaper** for a single family home in the EU to use renewable electricity in **heat pumps** vs. renewable electrolysis hydrogen in a **boiler**.

December, 2050

Single-family household
XXXXXX XXX
XXXXX EU Member State

Annual Energy Cost: Heat Pump

Heat Pump Installation (Annuitized).....**€225**
Maintenance.....**€12**
Cost of Renewable Electricity.....**€342**
(Wind and Solar Energy)
Total €579



December, 2050

Single-family household
XXXXXXXX XXX
XXXXX EU Member State

Annual Energy Cost: Hydrogen Boiler

Boiler Installation (Annuitized).....**€49**
Maintenance.....**€98**
Cost of Renewable Electrolysis.....**€1124**
Hydrogen (from Wind and Solar Energy)
Total €1271



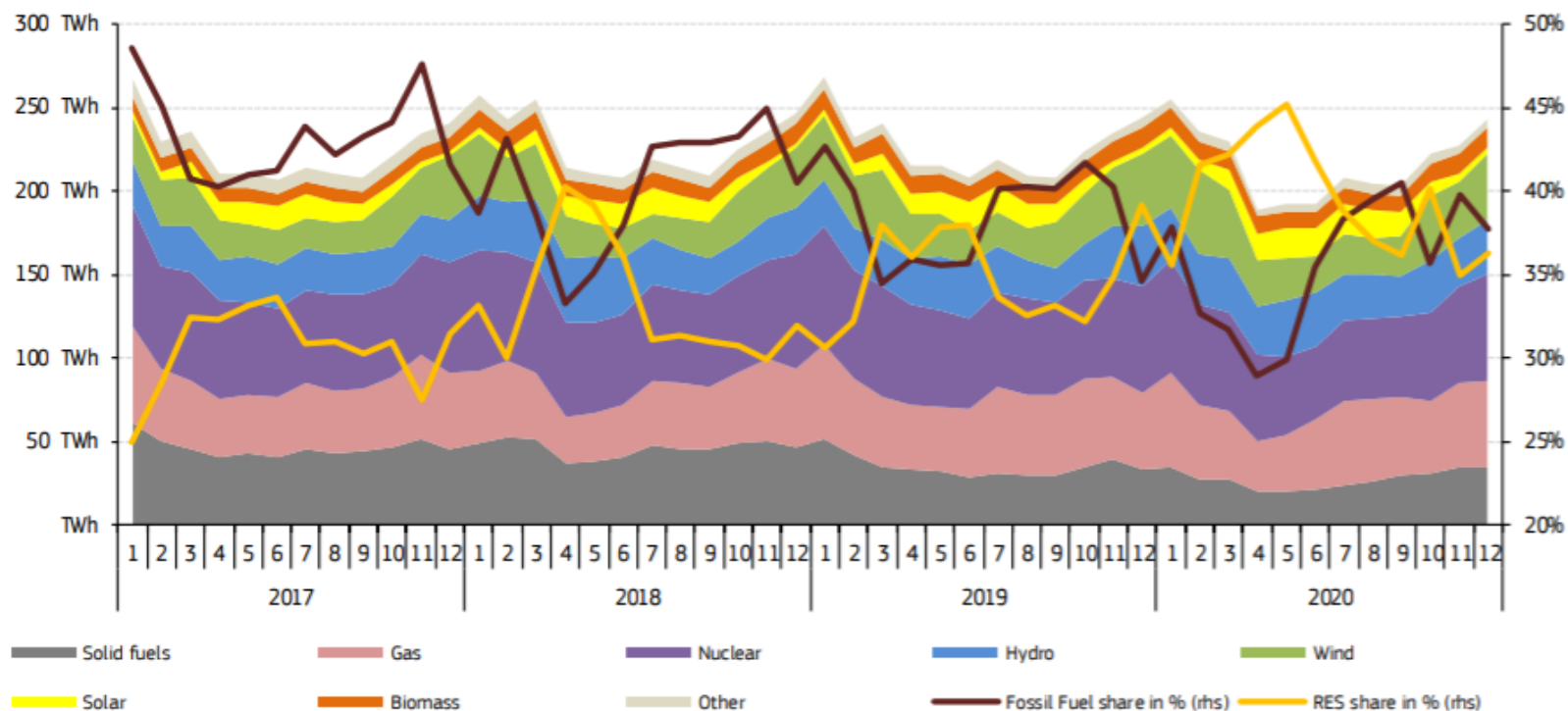
Source: ICCT, Hydrogen for heating? Decarbonization options for households in the European Union in 2050, March 2021



2. Reduce Environmental Impacts

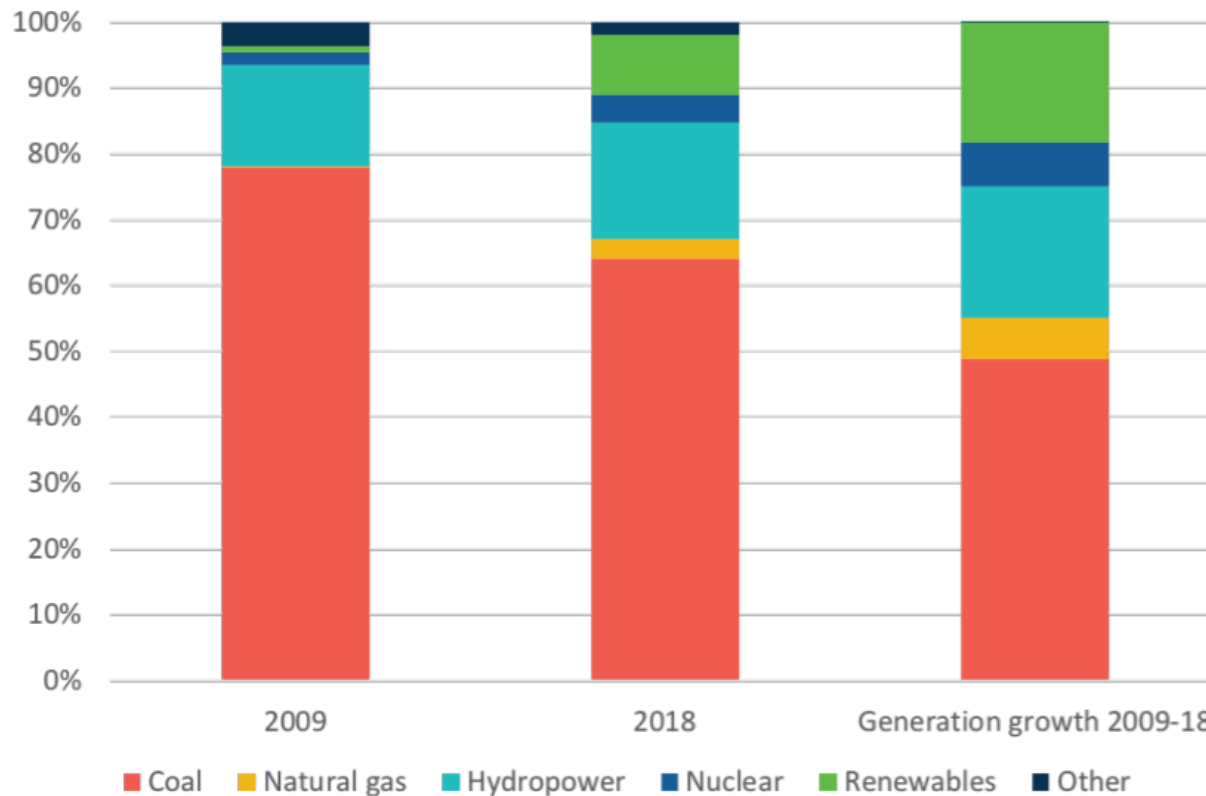
Electricity increasingly green

Figure 15 – Monthly electricity generation mix in the EU



Source: Quarterly Report on European Electricity Markets with focus on the developments in annual wholesale prices, Market Observatory for Energy, DG Energy, Volume 13, (issue 4, fourth quarter of 2020)

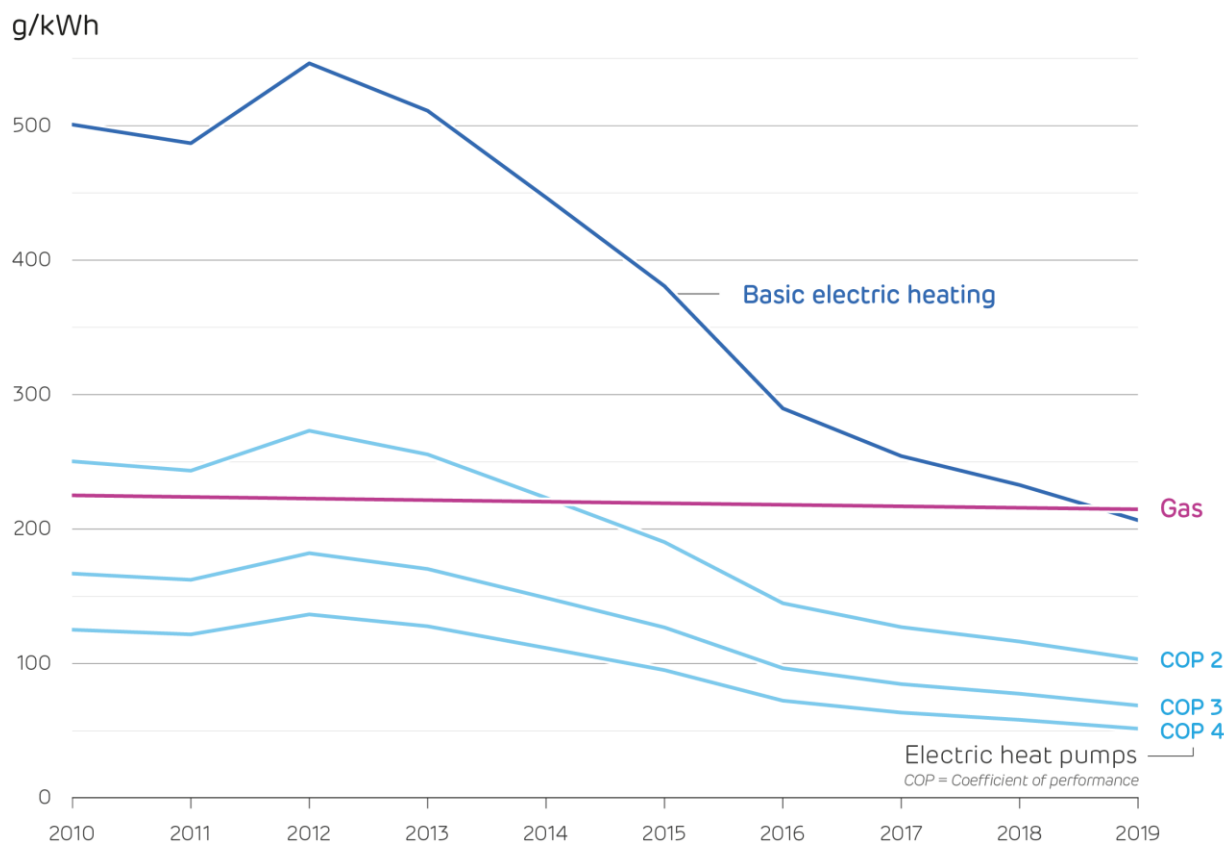
China's national electricity generation mix



Source: China Electricity Council. (2013-2019). *Table of Key Electricity Statistics*

Source: RAP, Electrification and Power Sector Reform: Coordinating Dual Challenges, 2020

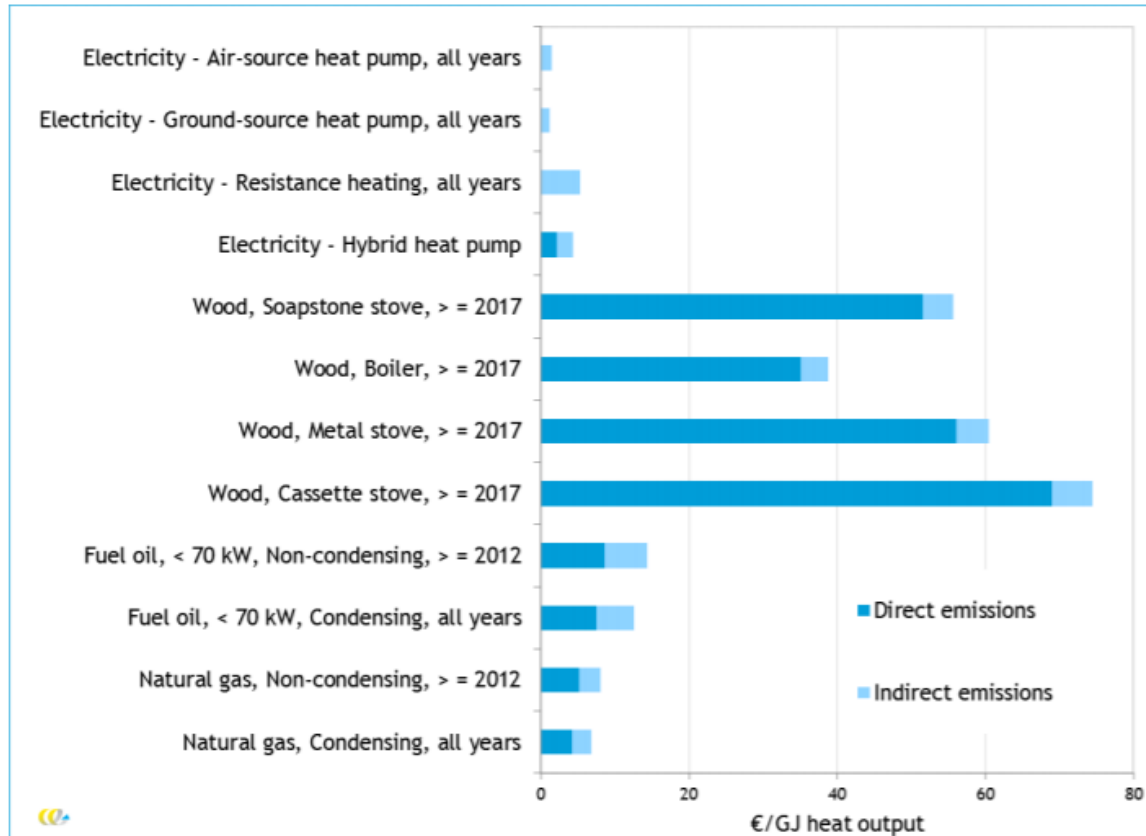
Heat pumps cleaner than gas – example UK



Source: Staffel 2019

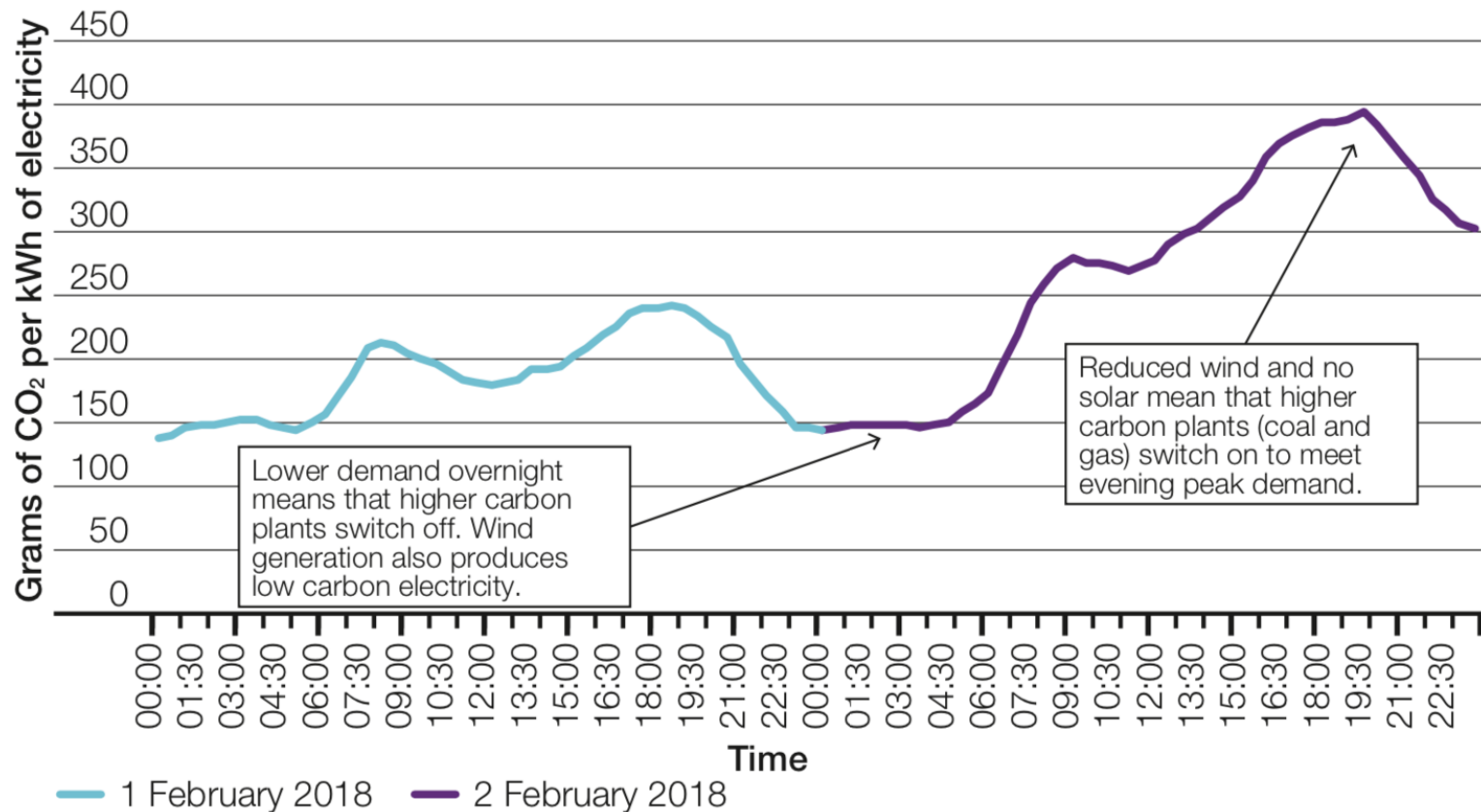
External cost of heating

figure 6: environmental damage costs of space-heating technologies: most advanced appliances (€/GJ heat output, normal scale)



Source: CE Delft, Milieuschadekosten van verschillende technologieën voor woningverwarming, 2019

Understand the emissions effects of changes in load



3. Enable Better Grid Management

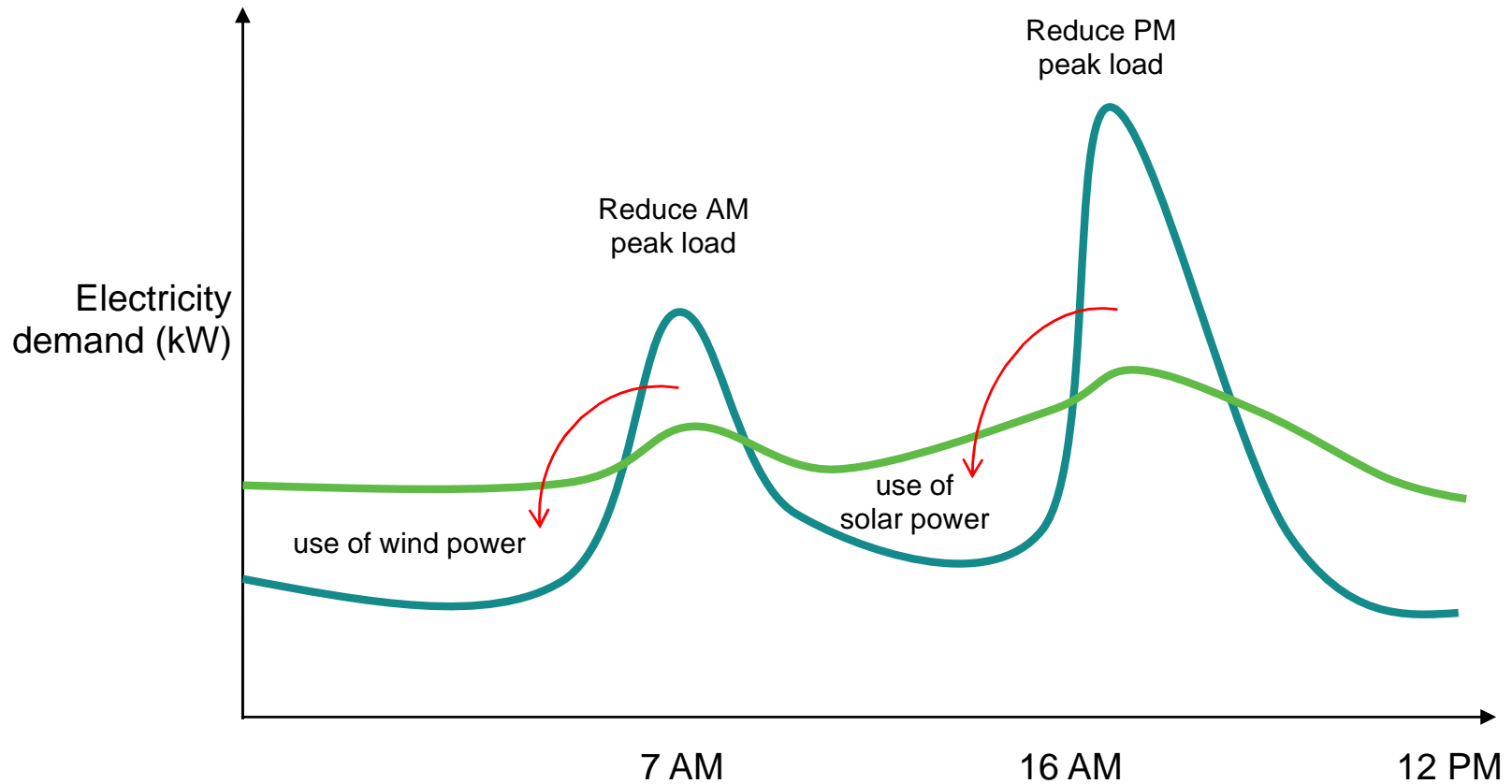


Managing Load

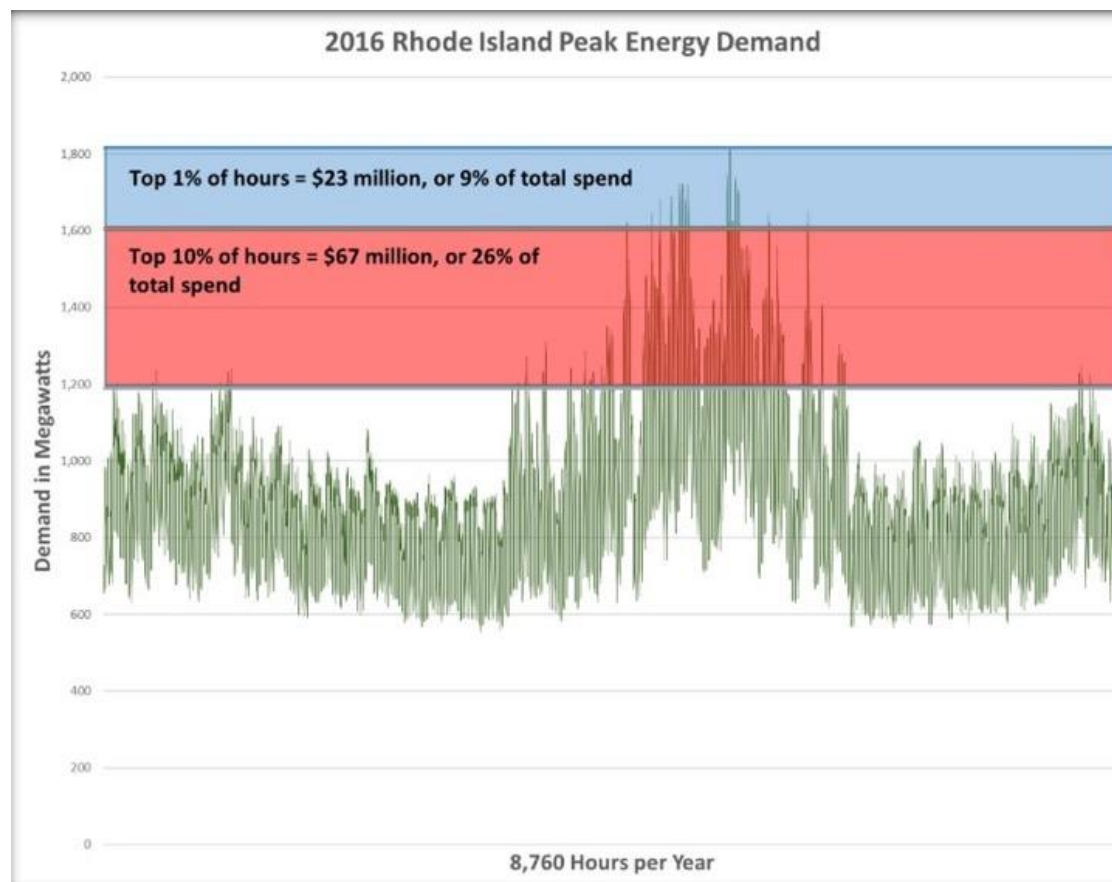
- EVs and HPs can be a **benefit** ... or a **problem** for the grid.
- Draw high amounts of power for short periods of time.



Recognize value of flexible load

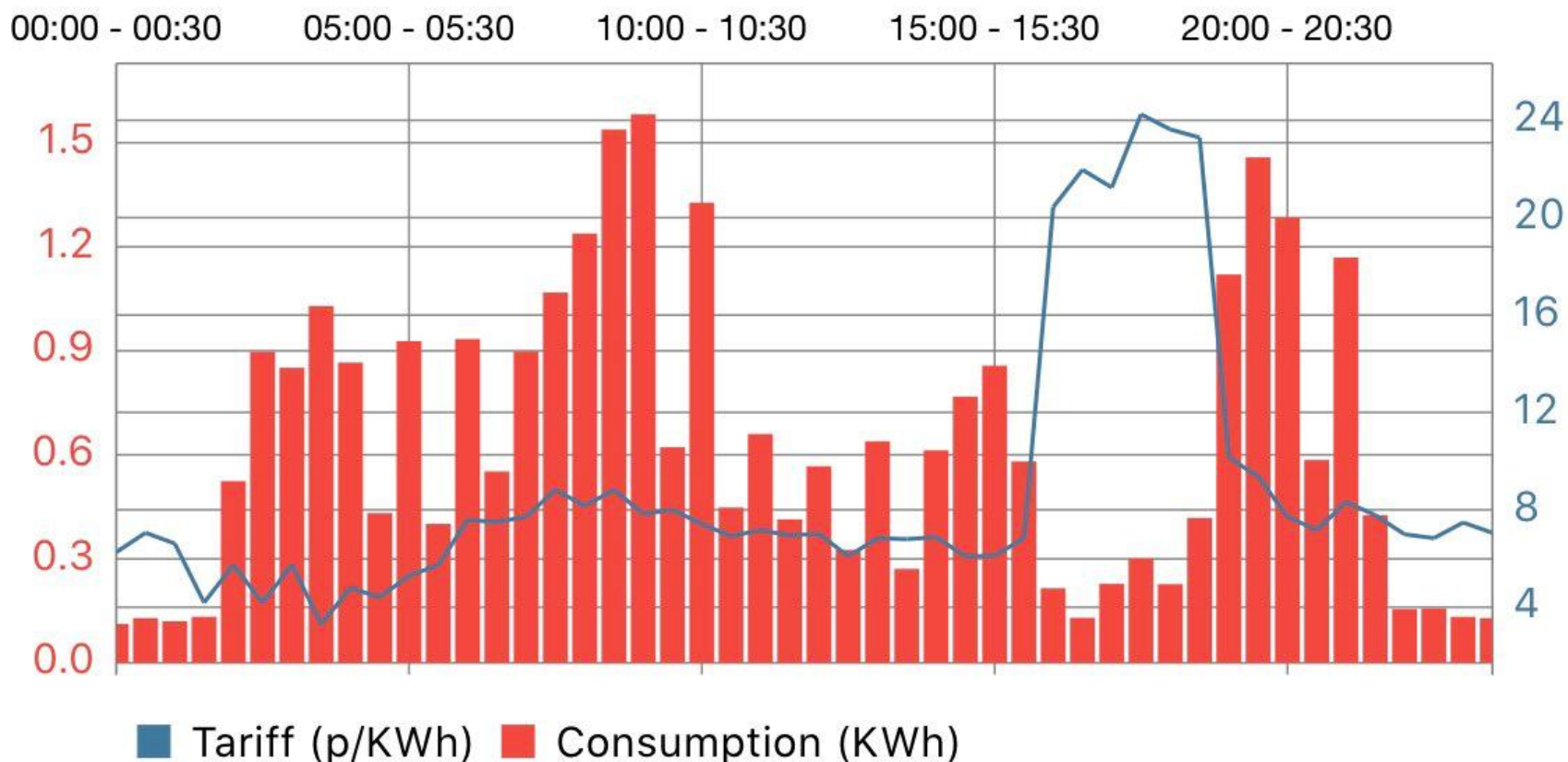


At least, avoid high-cost hours

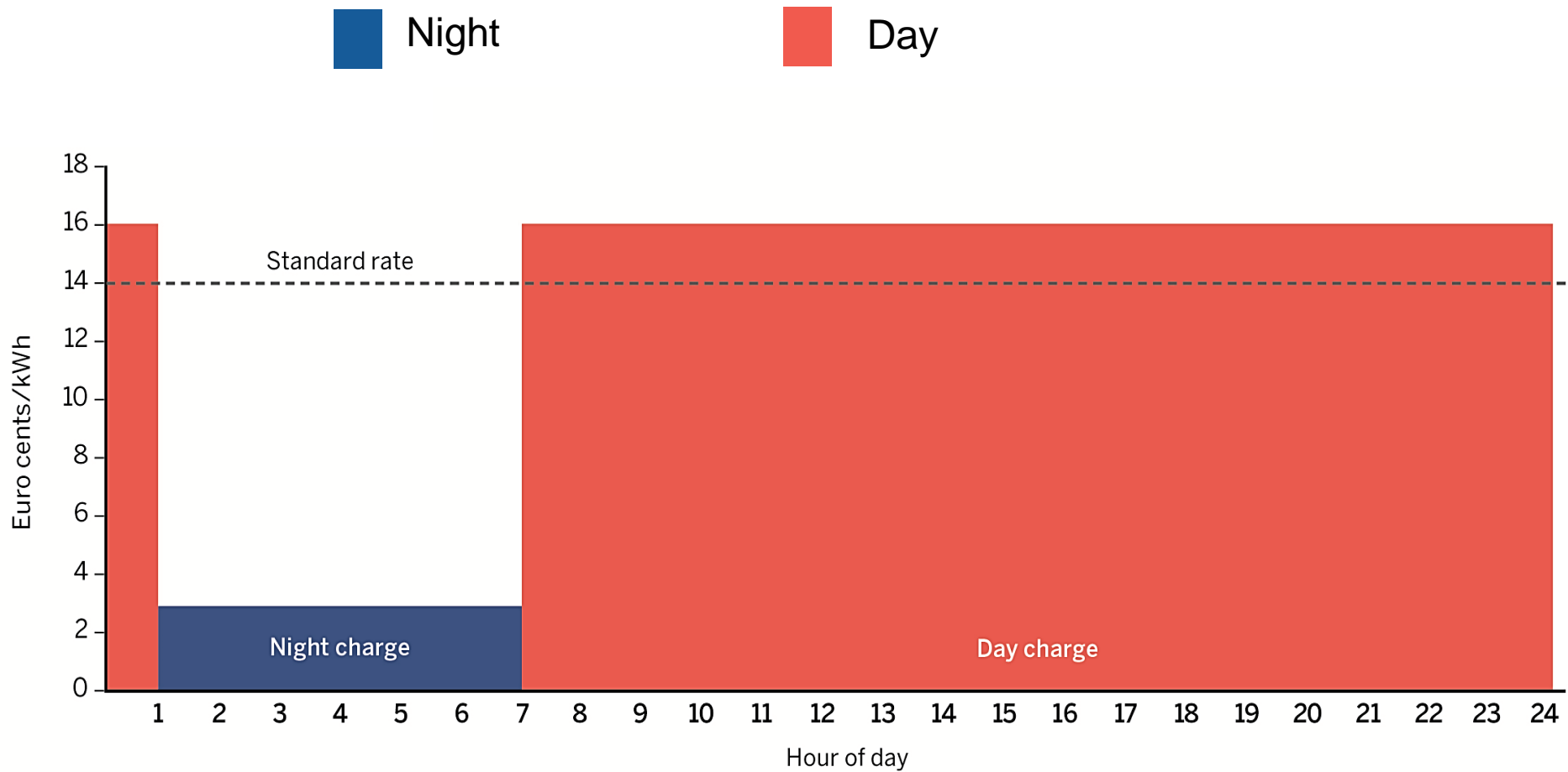


Source: Rhode Island Power Sector Transformation, Phase One Report to Governor Gina M. Raimondo (November 2017)

Design tariffs to reward flexibility



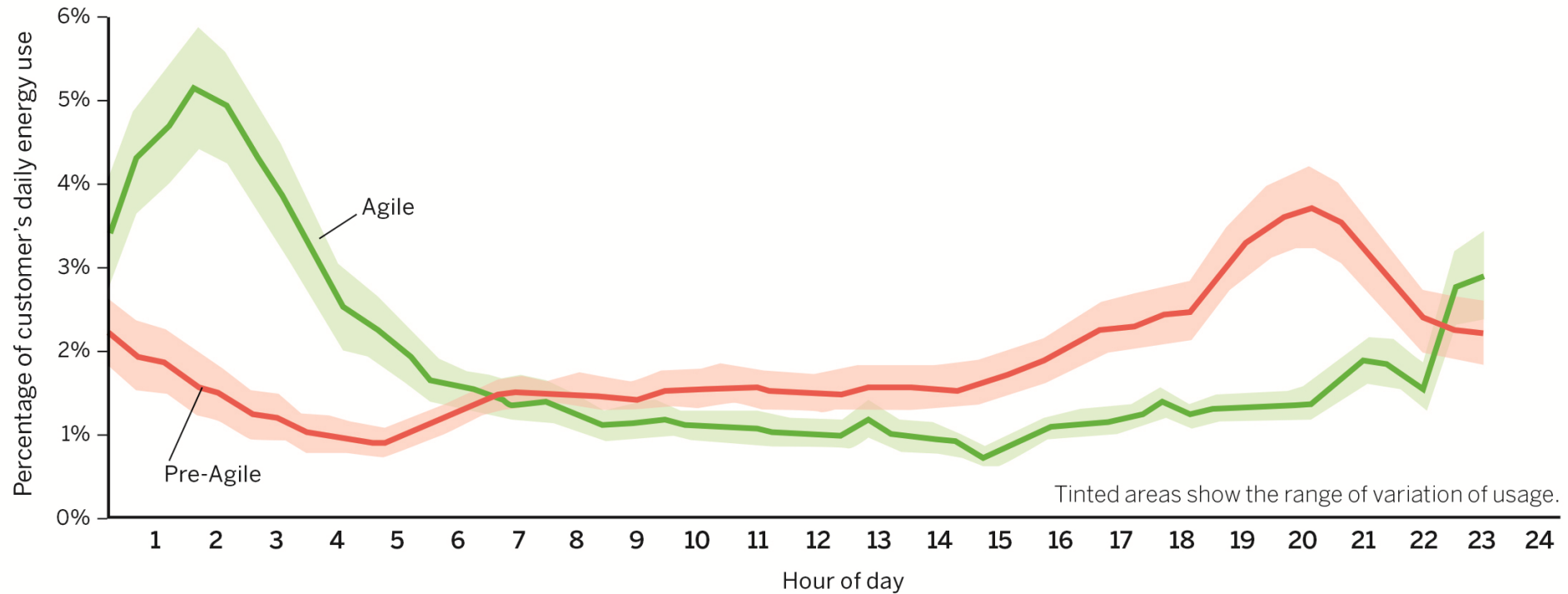
Simple time-of-use tariffs



Source: Based on Iberdrola. *Electric vehicle plan*.

More dynamic tariffs

Electric vehicle owners' charging habits on dynamic tariff



Source: Octopus Energy. (2018). *Agile Octopus: A consumer-led shift to a low carbon future*.

Strategies for smart EV integration



Smart
pricing



Smart
technology



Smart
infrastructure

Principles for [heat] electrification

- Efficiency first
- Recognize the value of flexible heat load
- Understand emissions effects of changes in load
- Design tariffs to reward flexibility

About RAP

睿博能源智库(The Regulatory Assistance Project (RAP)®) 是一个全球性专家咨询机构，长期致力于为欧洲、美国、中国、印度等国的电力行业改革所面临的挑战提供解决方案。我们在广泛的能源领域从事专业的技术和经济分析，特别是在电力行业规划和市场设计、能效和电力需求侧管理、空气质量管理、可再生能源并网、排放交易等方面有着资深的国际经验。

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