Planning Benefits of Dual-Fuel Gas-Electric Heating Technologies

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Introduction

- Energy policy trilemma (tensions between energy competitiveness, energy security, environmental protection) impedes energy planning
- Energy systems integration can provide investment flexibility, increase asset utilisation and system efficiency to face planning uncertainty
- In particular, the gas infrastructure can provide operational flexibility for power system
- Dual-fuel heating technology can strategically increase gas-electricity interactions to deliver system benefits

Objective:

➢ **Quantify planning costs and benefits of deploying dual-fuel heating technologies in the residential sector**

Dual-Fuel Heating Technology

- Option 1: Hybrid gas boiler and electric immersion heater (in return to gas boiler or water tank)
- Option 2: Hybrid heat pump and gas boiler

Future Heating Scenarios

	Main fuel	Single-fuel	Dual-fuel
S1	Gas heating	$S1_{single}$ Gas boiler only	$S1_{dual}$ with immersion heater
S2	Electric heating	$S2_{single}$ Heat pump only	$S2_{dual}$ with gas boiler

Methodology

- **Preliminary analysis to quantify research problem**
- Cost-benefit analysis including investment cost (heating technology, peak generation, mid-merit generation) and operational cost (fuel and carbon)
- Dispatch using simple block loading for each generation technology
- Control strategy and fuel-switching criterion
  - $S1_{dual}$: Maximise wind integration

    If wind curtailed, use electric immersion heater
  - $S2_{dual}$: Minimise peak load

    If elec. price double gas price, use gas heater

Test System

- Irish all-island system, Target year 2023
- Wind capacity 6000 MW and other generation capacities from Eirgrid capacity statement 2014-2023
- Share of households with new heating technology for all scenarios is 40%

Results

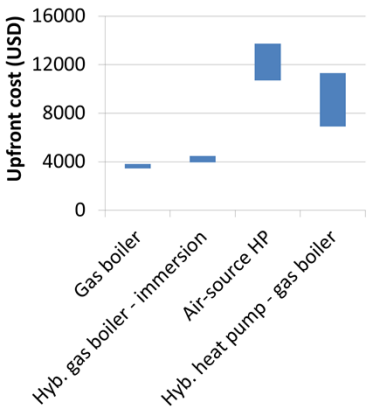


Fig. 1 Upfront cost of single and dual-fuel heating technologies

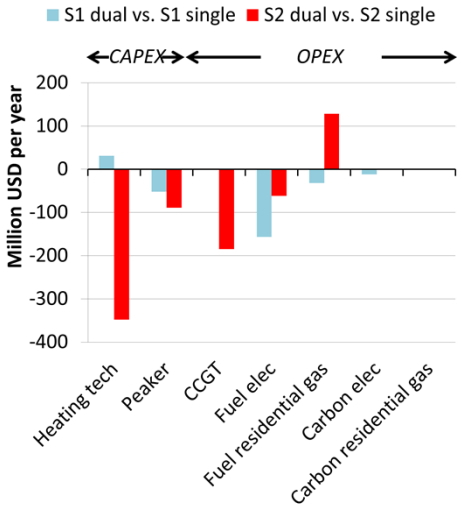


Fig. 2 Cost comparison of single and dual-fuel scenarios

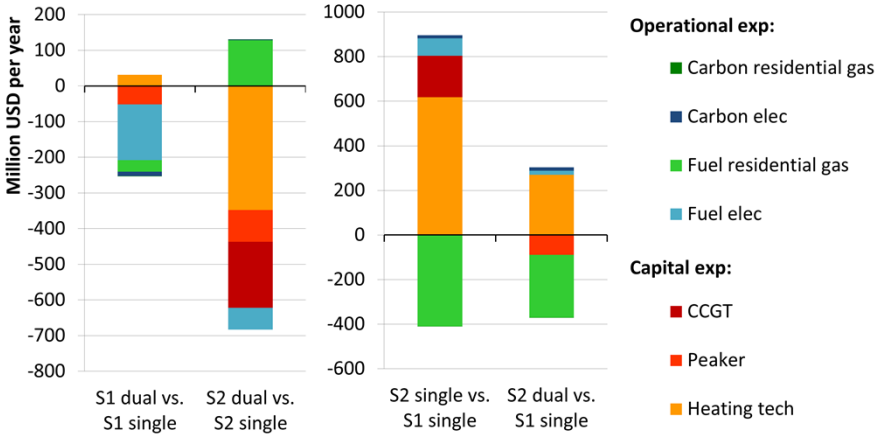


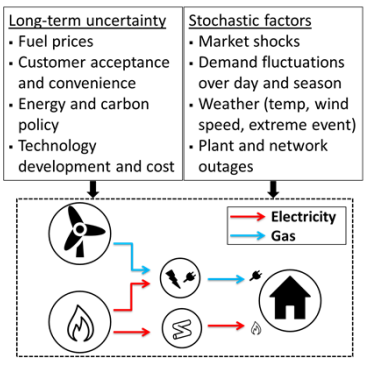
Fig. 3 Cost-benefit analysis for different future residential heating scenarios

Conclusions

- **Gas infrastructure can deliver investment and operation flexibility to electricity system**
- **Dual-fuel technologies provide investment and operational benefits compared to single-fuel options**
- **System-wide analysis improves the value proposition of dual-fuel heating technologies beyond the building level**

Future Analysis

- **Integrate a fast capacity expansion algorithm into the methodology**
- **Quantify uncertainty management benefits in planning process:** Evaluate cost-benefit of dual-fuel technology for a wide portfolio of fuel prices, consumer preferences and energy policies
- **Energy security benefits:** Evaluate system benefits facing stochastic variation of fuel supply and weather conditions



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