The Future of Heat Pumps

Electrification Academy

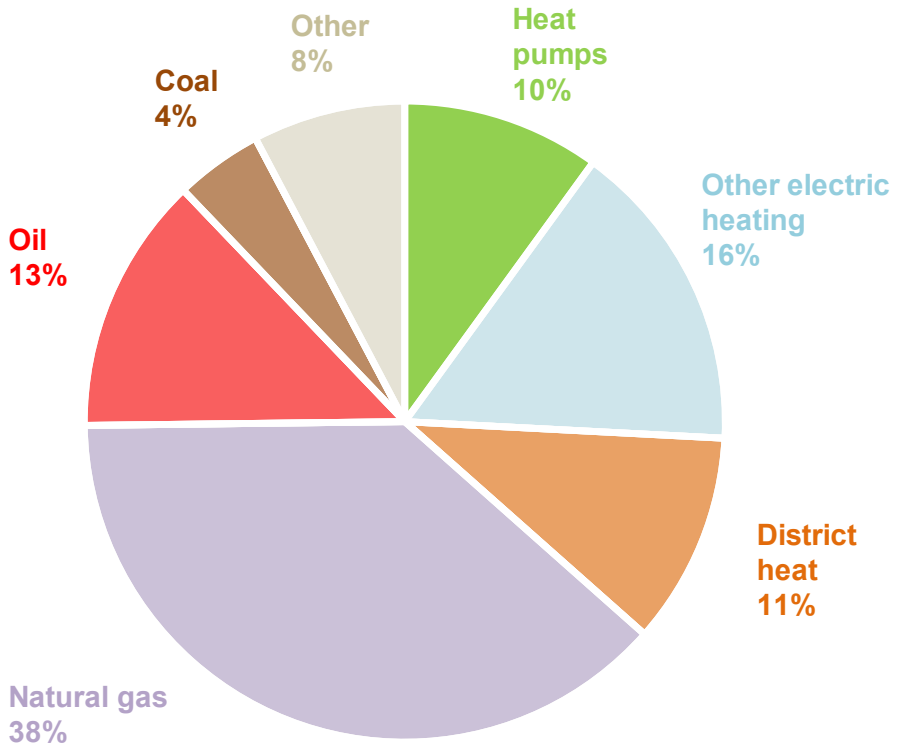
15 December, 2022

Yannick Monschauer

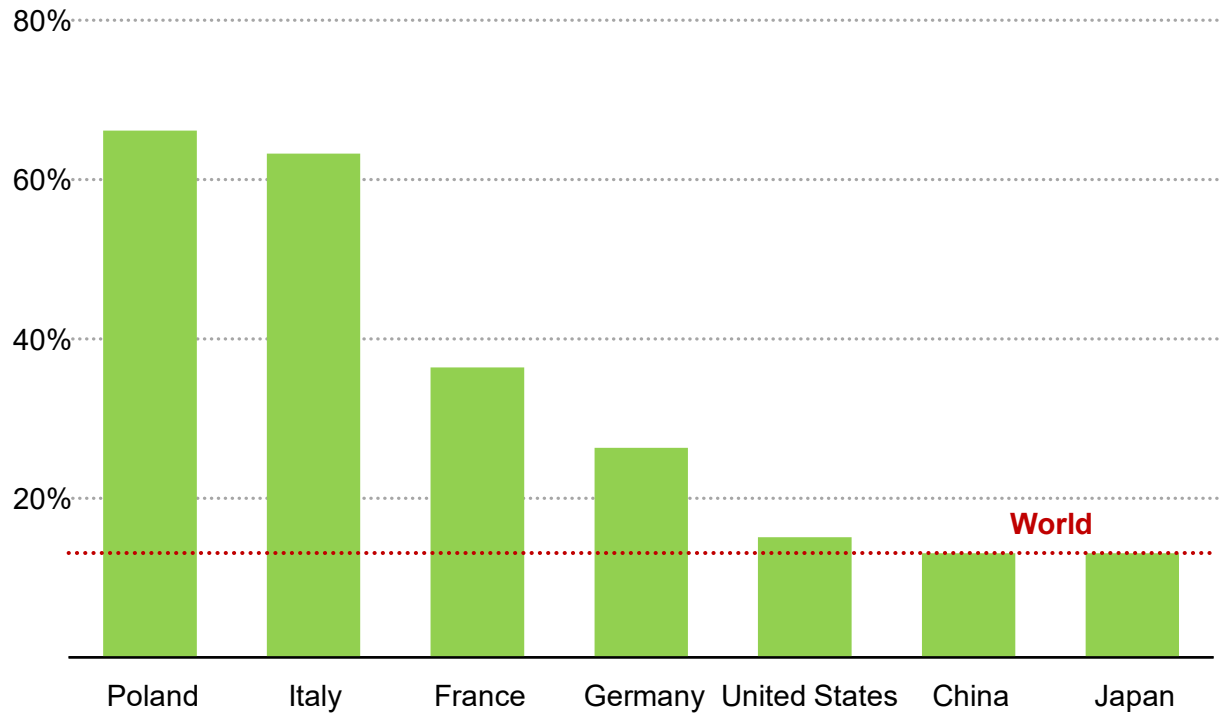
International Energy Agency

Heat pumps are a proven technology, and sales are growing rapidly

Buildings heating needs by source, 2021

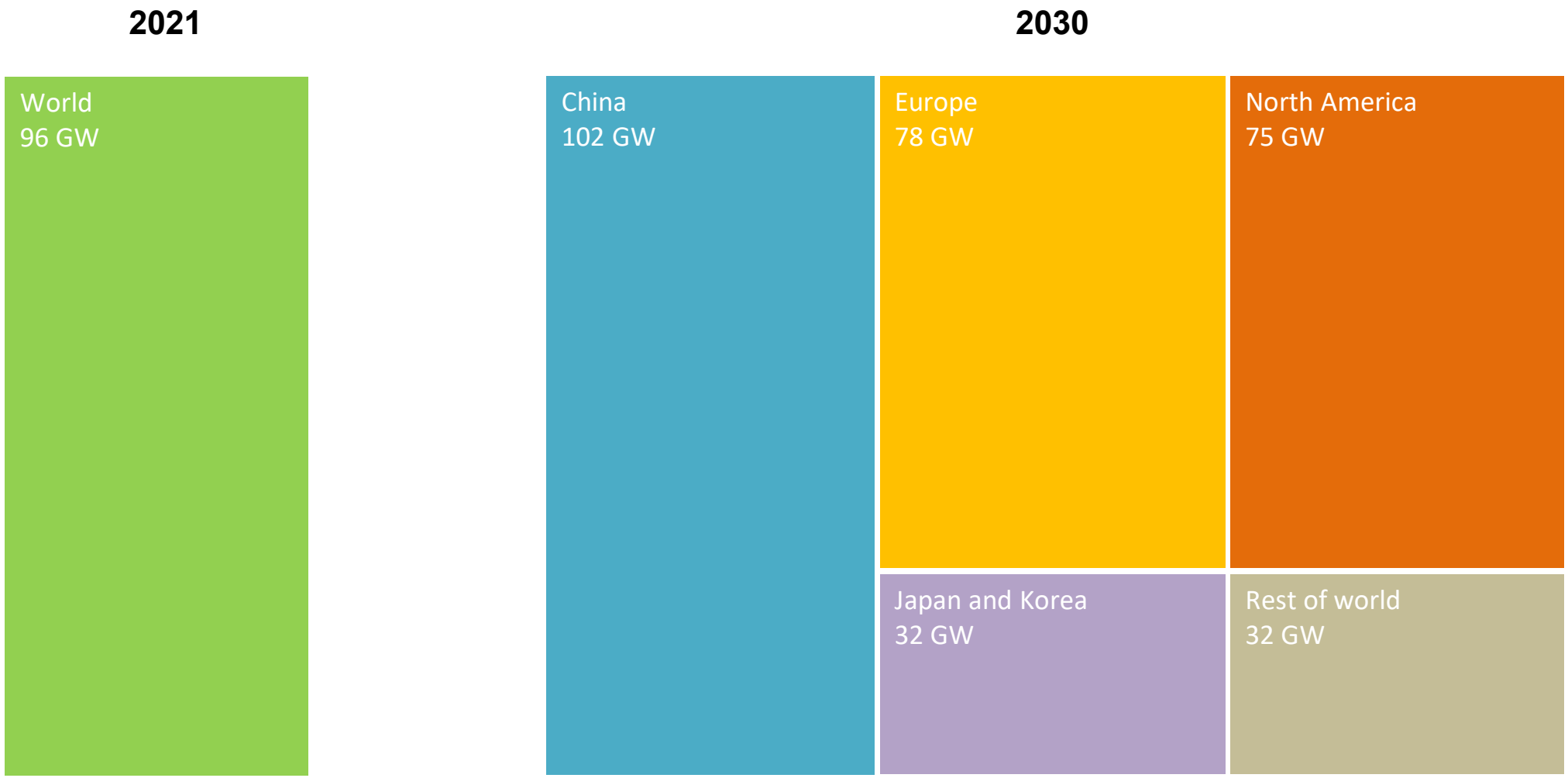


Heat pumps sales growth rate, 2020-2021



Around 10% of buildings heating needs in 2021 were met by heat pumps, with much larger shares in leading markets. Sales are growing rapidly, especially in the European Union, which saw 35% growth in 2021.

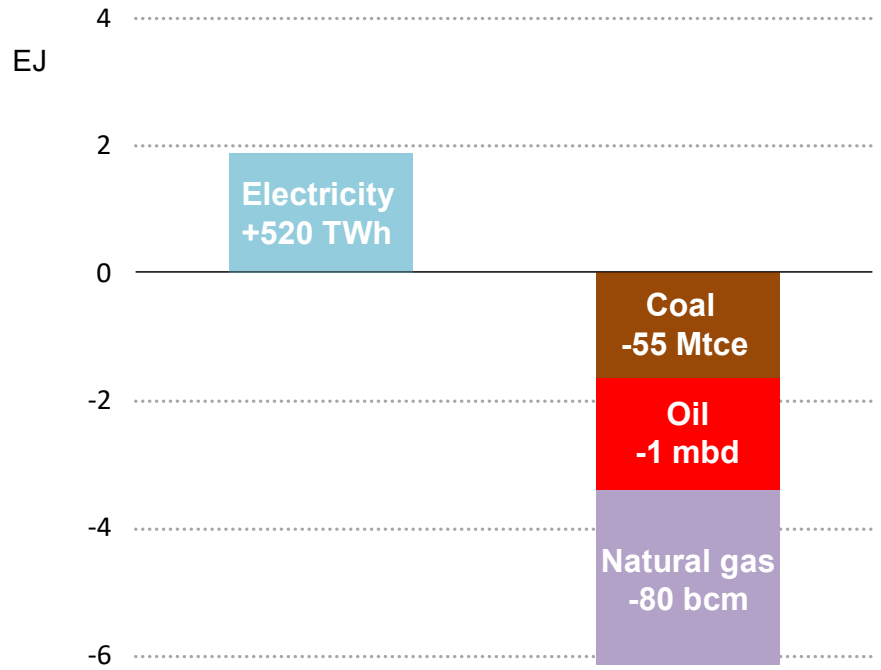
Heat pump markets grow rapidly to 2030



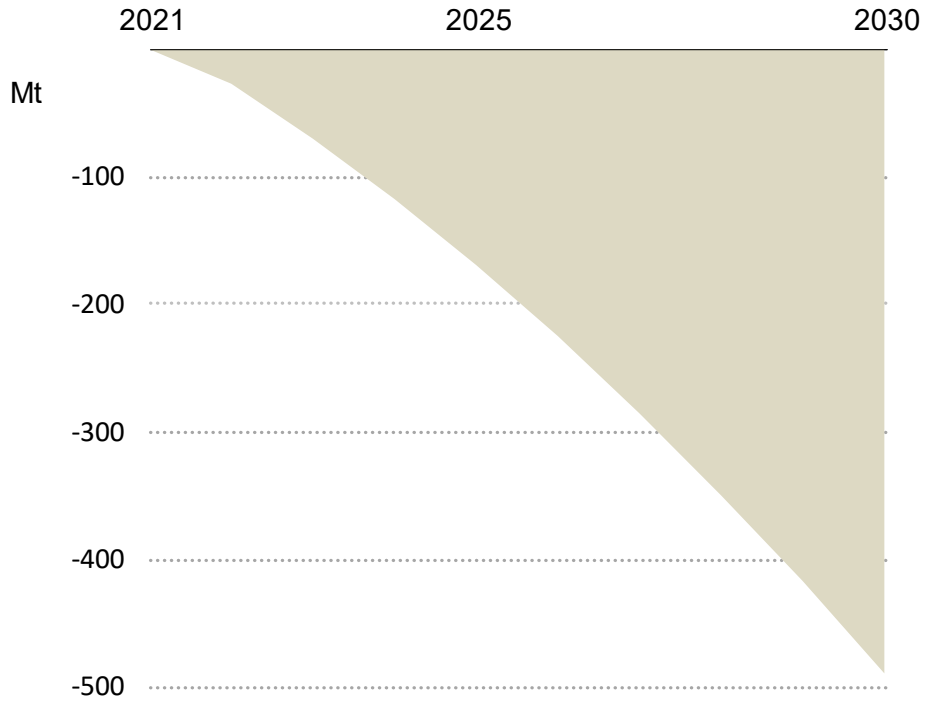
Announced energy- and climate-related commitments will push heat pump sales to triple by 2030, driving a scale up in the global heat pump supply chain.

Heat pumps are *the* main technology for secure & sustainable heating

Change in buildings heating energy demand, 2021-2030

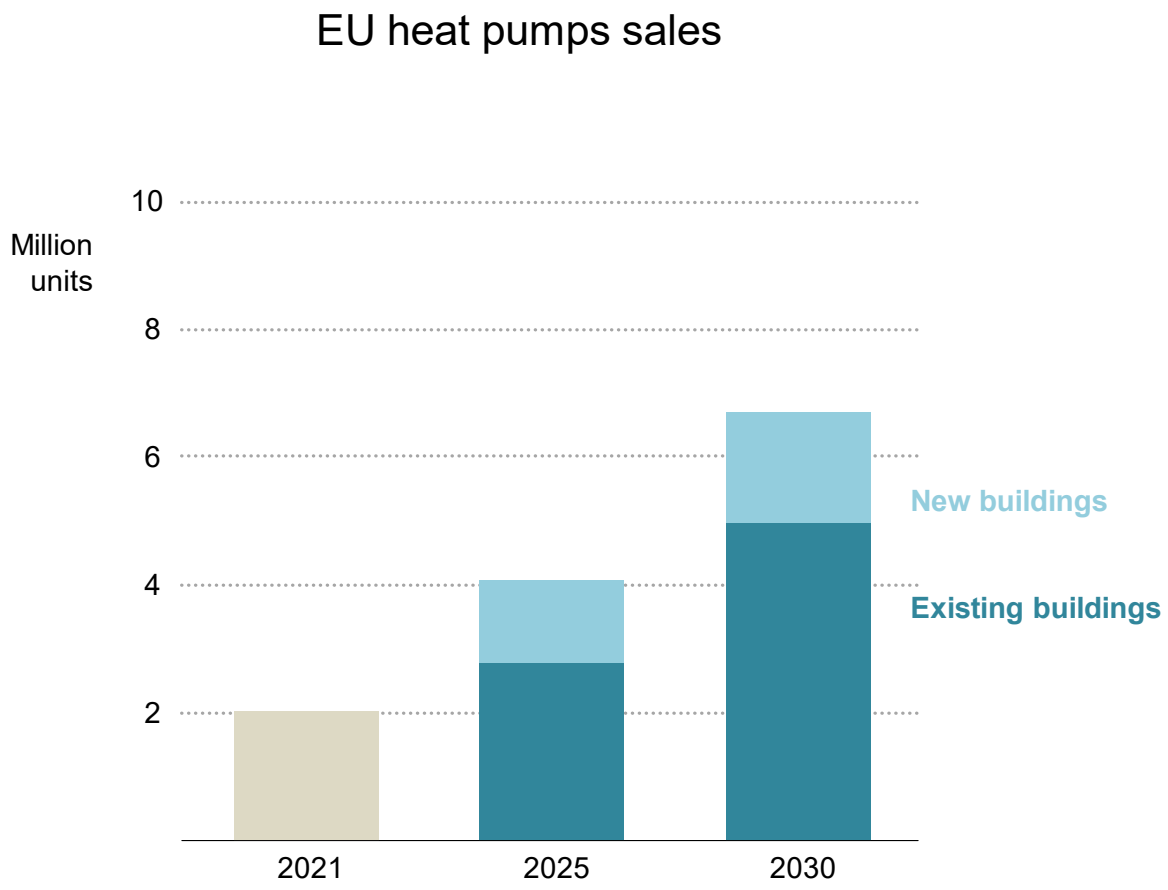


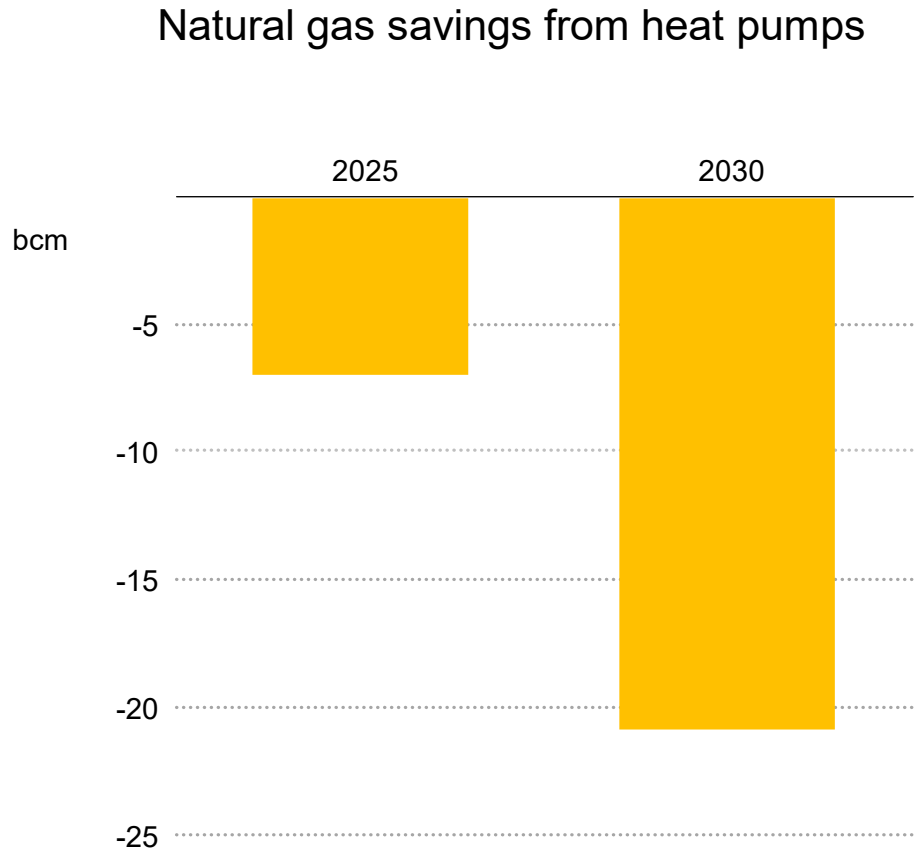
CO_2 emissions savings to 2030



Heat pumps contribute nearly half the reductions in fossil fuel use in heating by 2030, cutting natural gas demand by over 80 bcm. They contribute 500 Mt CO_2 emissions savings to 2030.

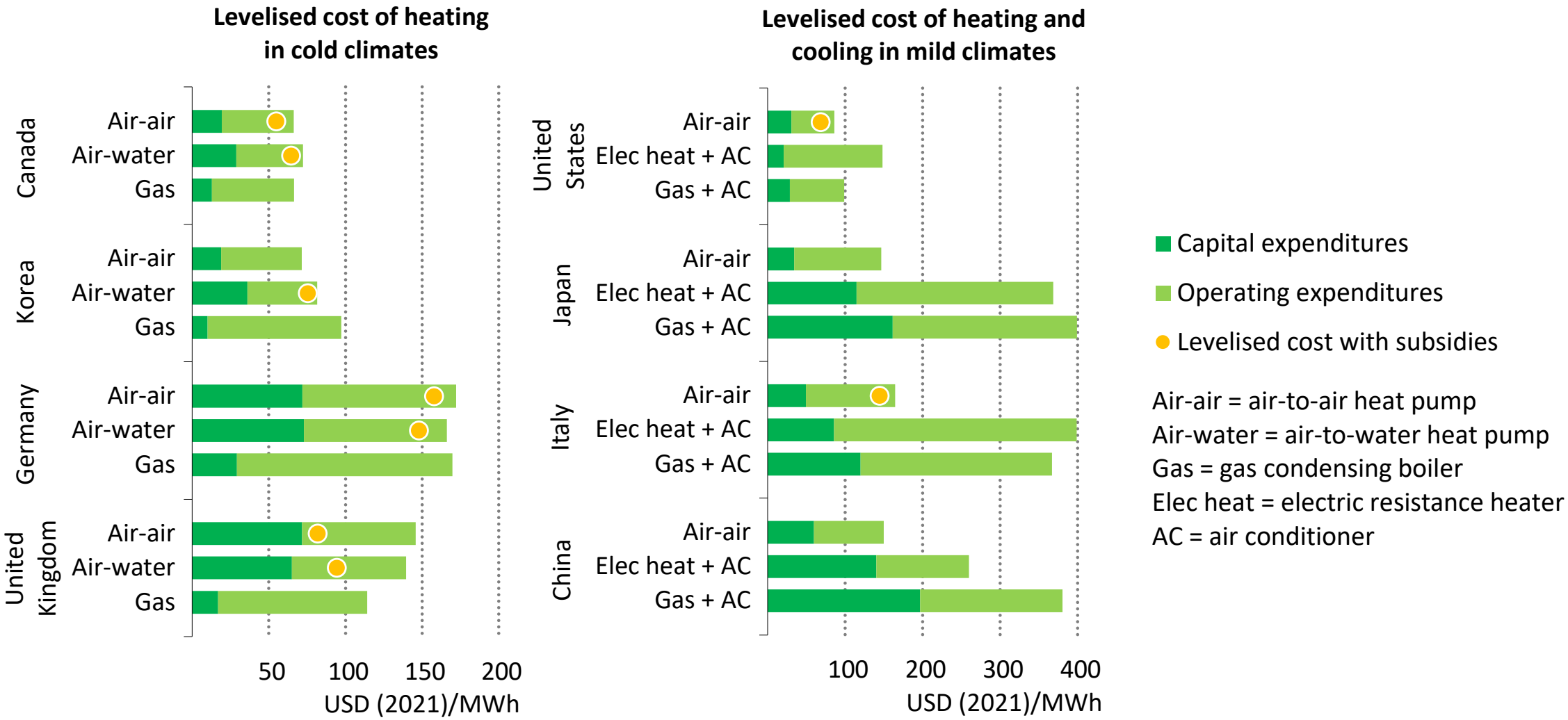
Heat pumps help reduce EU natural gas dependency





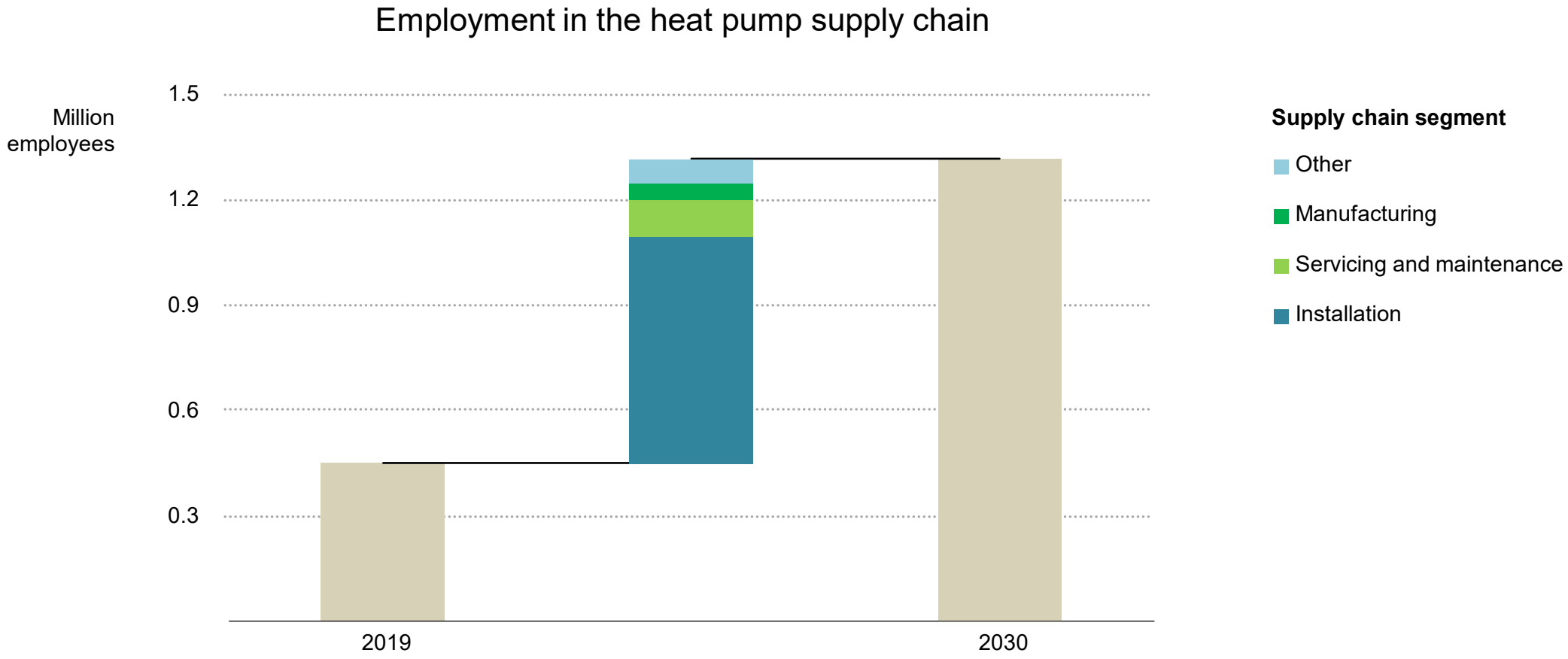
Plans by leading EU manufacturers to invest nearly EUR 4 billion in heat pump manufacturing and related efforts help to accelerate sales, reducing EU natural gas consumption by 21 bcm by 2030.

Consumers save by switching to heat pumps, but barriers remain



Heat pumps save consumers money over their lifetime, but upfront costs remain high.
Financial incentives are available in countries covering 70% of heating today, helping bring down the upfront cost.

Heat pump growth creates jobs, but labour bottlenecks could arise

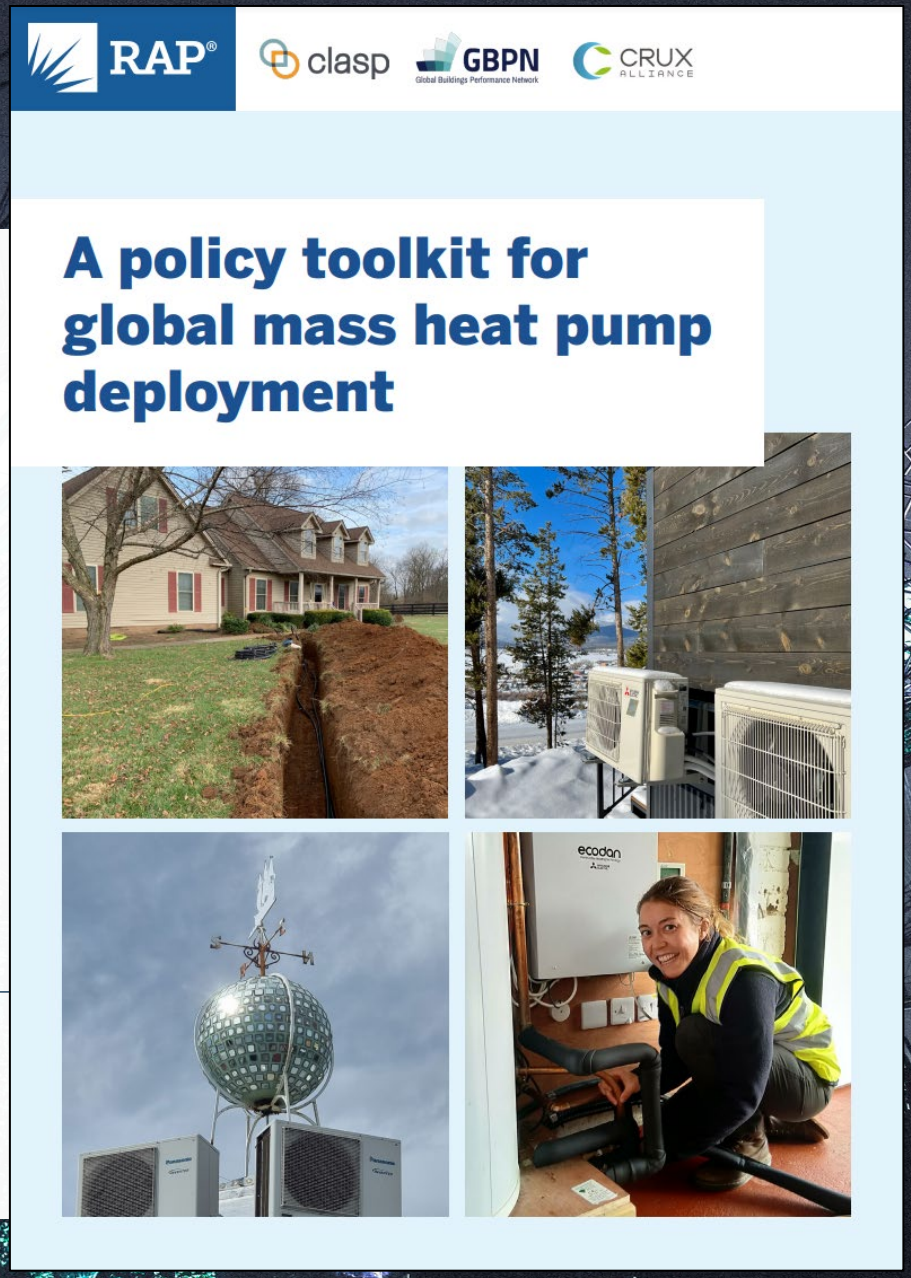


Employment related to heat pumps triples to 2030, with the most new jobs in installation. Many countries face shortages in occupations that would be able to quickly retrain to install heat pumps.

15 December 2022

Heat pumps and the heat pump policy toolkit

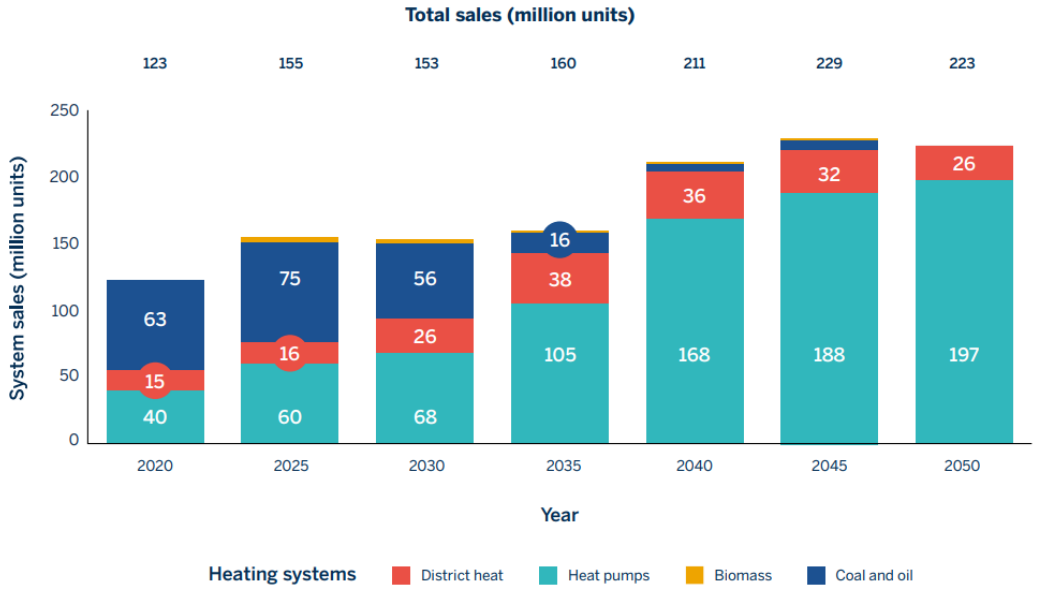
Electrification Academy December 2022



Why is a heat pump toolkit needed?

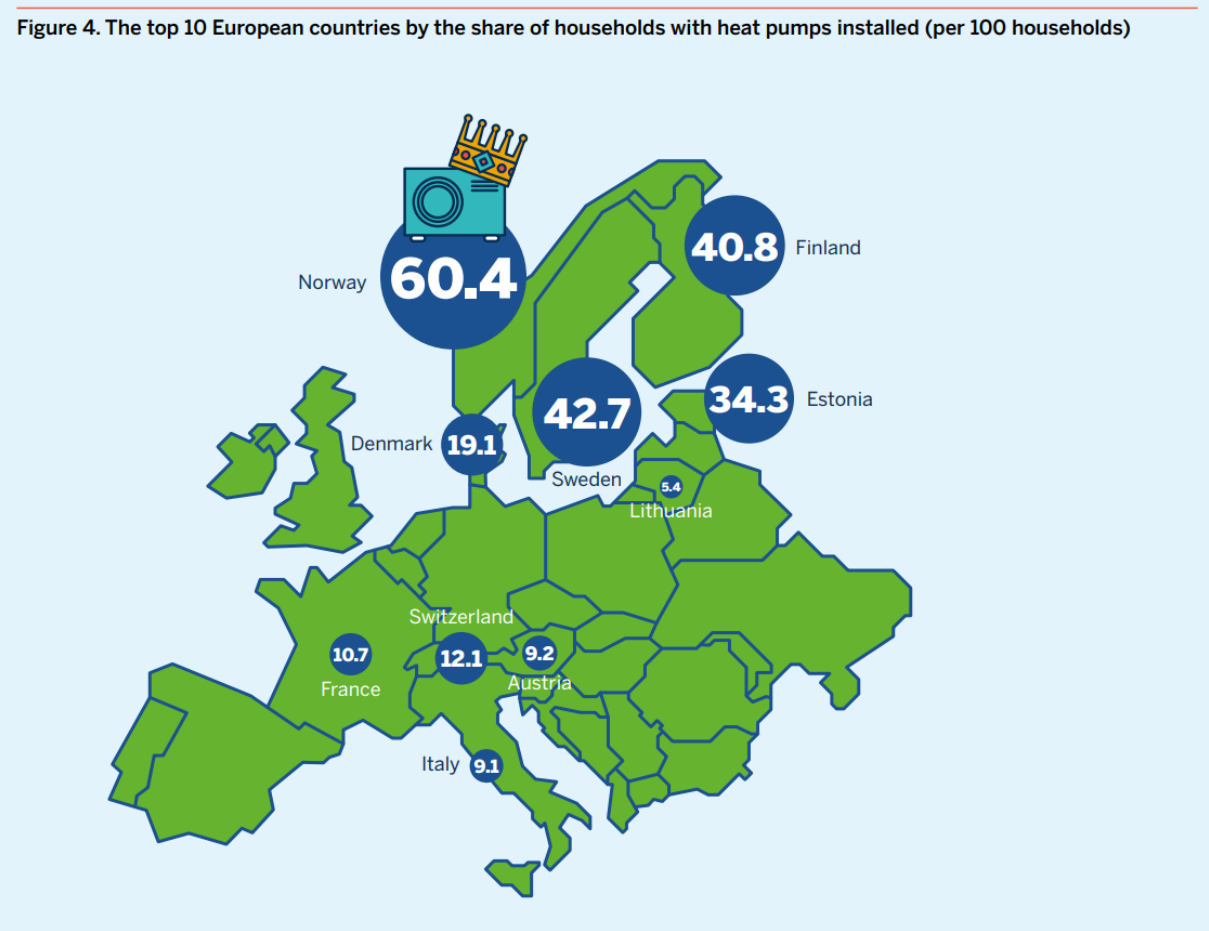
- A global strategically important technology.
  - Clean and secure.
- Very few globally focused studies specifically on heat pumps.
- Rapid progress is needed but knowledge varies between jurisdictions.

Figure 5. Global heating system sales under net-zero transition scenario



Source: McKinsey Global Institute. (2022, January). *The net-zero transition: What it would cost, what it could bring*.
Note: Copyright (c) 2022 McKinsey & Company. All rights reserved. Reprinted with permission.

What can we learn from others?

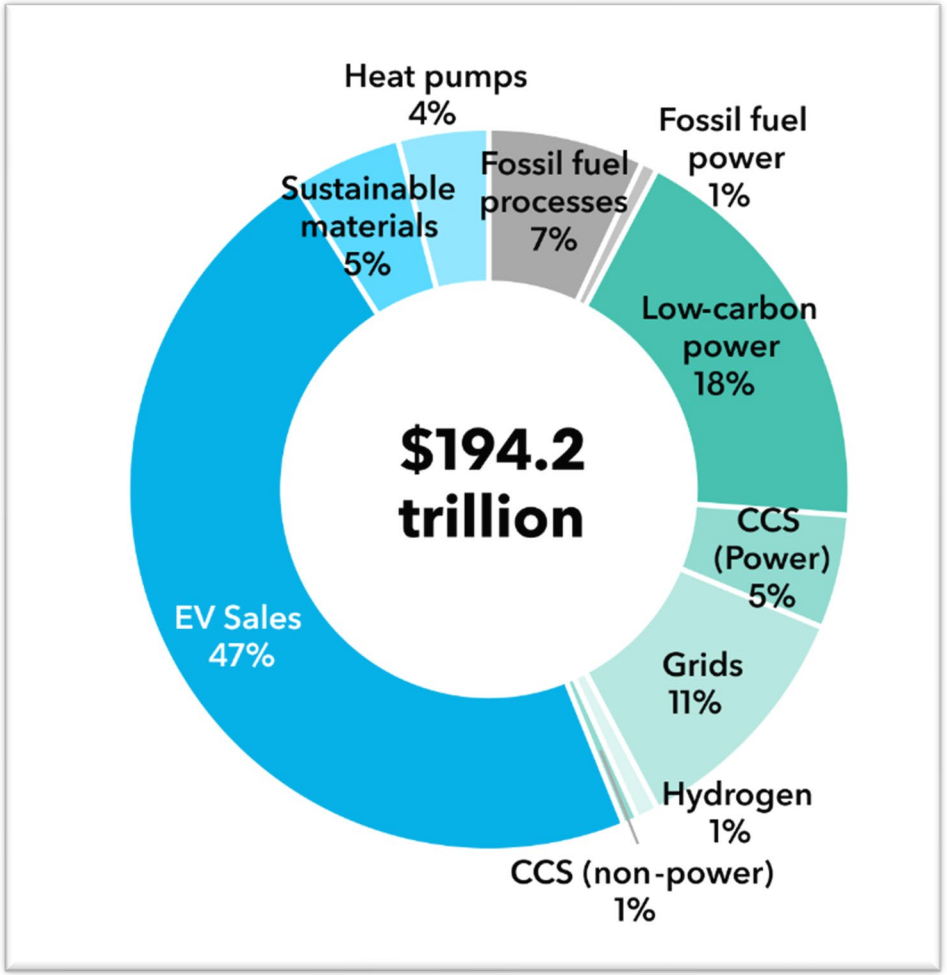


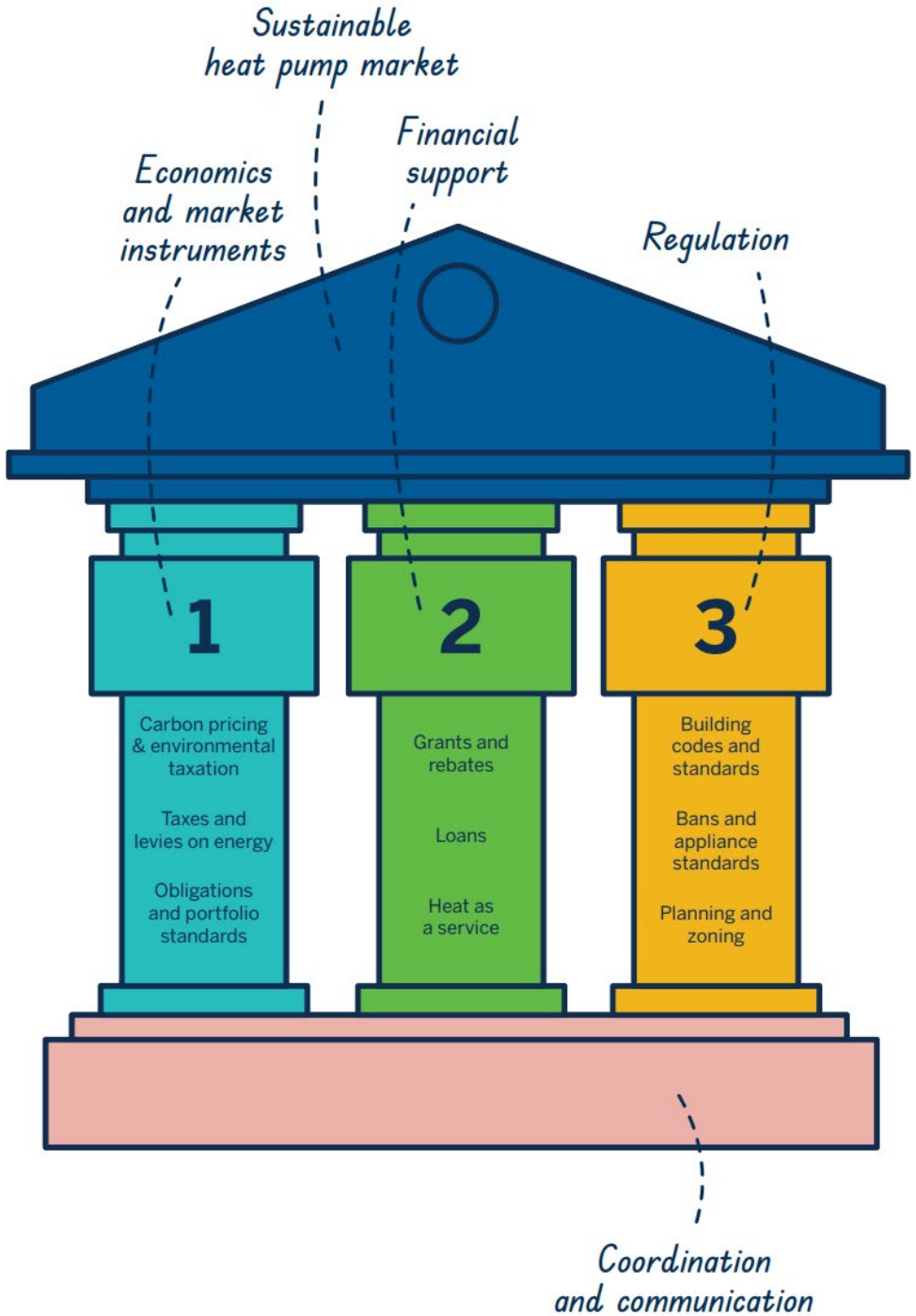
1. Measures to support consumer confidence are needed.
2. Focus on standards and skills.
3. Policy support should be stable.
4. Financial and economic support a requirement.
5. Policy packages a must.

Making the toolkit equitable

- Significant capital is needed (circa $8 trillion).
- 1st time switches to heat pumps will likely cost more than a FF system.
  - Many households will need support.
- Energy prices vary significantly.
  - Policy should ensure switching to a heat pump lowers bills.

BloombergNEF New Energy Outlook 2022 Net Zero Scenario

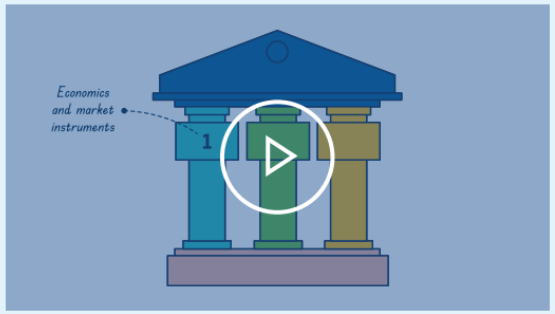



Sustainable heat pump market
Economics and market instruments
Financial support
Regulation
1
2
3
Carbon pricing & environmental taxation
Taxes and levies on energy
Obligations and portfolio standards
Grants and rebates
Loans
Heat as a service
Building codes and standards
Bans and appliance standards
Planning and zoning
Coordination and communication

8 Pillar 1: Economic and market-based instruments

Heat pumps currently often cost more to install than fossil fuel heating systems, and running costs compared to fossil fuel heating are often similar but vary by country or region. Policymakers should ensure that there is a clear financial incentive for building owners to invest in heat pumps, an issue considered in this chapter and in the short video below.

Figure 9. Policy toolkit pillar 1



Note: Click for a link to section summary video.

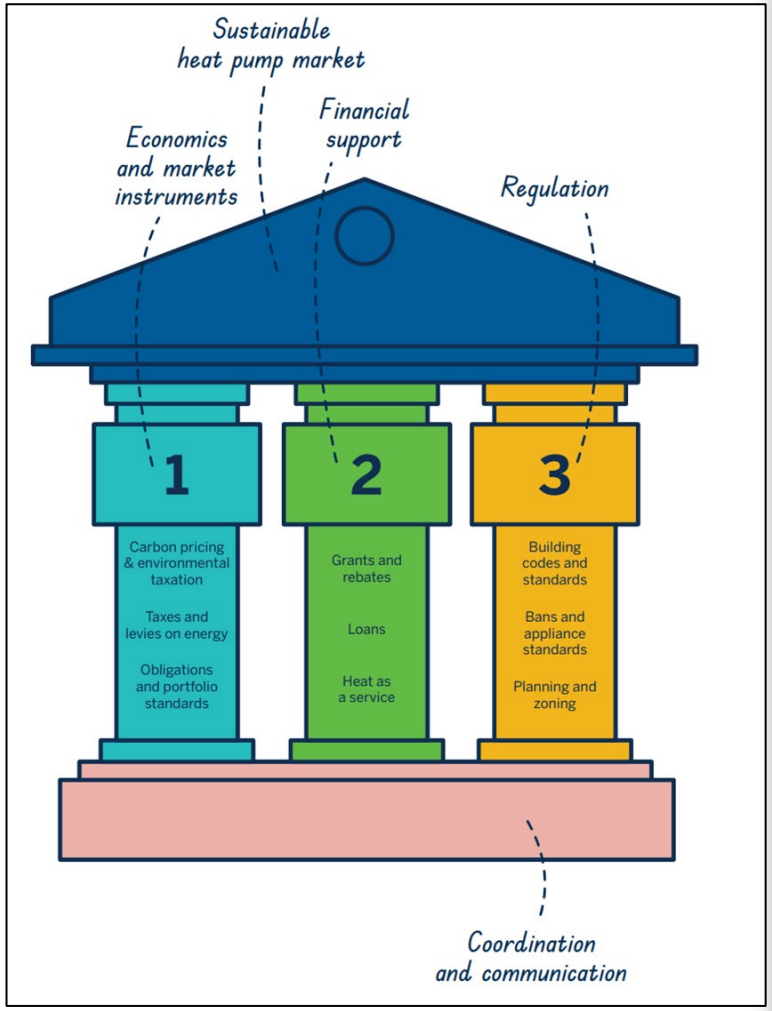
Without a strong economic framework on both upfront heat pump costs and running costs, heat pump deployment is expected to be far slower than needed to reach net-zero emissions targets.[59]

The main running costs (associated with electricity used by the heat pump) will be determined by the cost of electricity, the efficiency of the heat pump and the overall heat demand of the building. If fossil fuels such as oil, gas and coal are cheaper to use per unit of heat delivered, there is a disincentive for customers to switch to heat pumps.

Even if the upfront heat pump costs can be reduced or subsidised, buildings and households that switch to a heat pump would see their running costs increase. It would also be a challenge to encourage the deployment of heat pumps through regulation if their operating costs were higher than existing fossil fuel systems.

There are several ways in which governments can change the economics of clean heating and incentivise people to adopt heat pumps. Subsections in this toolkit chapter consider carbon pricing and environmental taxation, taxes and levies on energy and obligations to develop markets. To shift the economics towards clean heating, combinations of such measures may be appropriate.

59 Rosenow et al., 2022a.



8.1 Carbon pricing and environmental taxation

Reflecting environmental costs in energy prices aligns the incentives facing energy users with environmental policy goals. This can support heat pump markets, by making their operating costs relatively more attractive, and provide revenues to support building retrofits and heat pump financial support programmes, such as those discussed in Section 9. Such pricing reform can also support wider electrification.

How does it work?

Governments can tax environmental pollutants based on estimates of their environmental impacts. The most taxed pollutant is carbon dioxide, but some countries also tax other emissions. An alternative to a tax is an emissions trading system (ETS), such as the EU ETS, in which the allowable quantity of emissions is set, with obligated parties required to hold allowances to cover their emissions. The ability to trade creates a market in which the marginal cost of reducing emissions should be revealed.

Examples

In the EU, carbon pricing is in place on directly combusted heating fuels (fossil gas, heating oil) in 10 Member States.[60] Only in Sweden, however, is the carbon price on fossil heat higher than the EU ETS allowance price, which is passed through to electricity users.[61] Denmark has a comprehensive approach, taxing carbon dioxide, nitrogen oxides and sulphur dioxide emissions.[62] In 2021, the European Commission proposed an EU-wide trading system for carbon emissions from the buildings and road transport sectors (ETS 2), which would come into effect in the second half of the 2020s.[63] The commission also proposed a reform of the Energy Taxation Directive that would ensure that electricity was always the least taxed energy carrier, reflecting its lower environmental damage costs when compared with fossil fuels and biomass.[64]

Canada has a carbon tax that covers buildings, heating fuels and the power sector, with provinces able to set up their own schemes if at least equivalent. The Canadian carbon tax is set to increase each year from 50 to 170 Canadian dollars by 2030.[65] South Korea has the world's most comprehensive emissions trading system, covering over 95% of carbon emissions, including those from heating fuels in large buildings.[66]

60 Sweden, Finland, France, Ireland, Denmark, Portugal, Luxembourg, Slovenia, Germany and Austria have instituted carbon taxes or ETSs covering heating fuels.

61 Thomas, S., Sunderland, L. & Santini, M. (2021, June). *Pricing is just the icing: The role of carbon pricing in a comprehensive policy framework to decarbonise the EU buildings sector.* Regulatory Assistance Project. https://www.raponline.org/knowledge-center/pricing-just-icing-role-carbon-pricing-comprehensive-policy-framework-decarbonise-eu-buildings-sector/

62 OECD. (n.d.). *Revenue from environmentally related taxes in Denmark.* https://www.oecd.org/tax/tax-policy/environmental-tax-profile-denmark.pdf

63 European Commission. (2021a, July). *Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757.* https://ec.europa.eu/info/sites/default/files/revision-eu-ets_with-annex_en_0.pdf

64 European Commission. (2021b, July). *Revision of the Energy Taxation Directive (ETD): Questions and Answers.* https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_3662

65 Government of Canada. (n.d.[a.]). *The federal carbon pollution pricing benchmark.* https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/carbon-pollution-pricing-federal-benchmark-information.html

66 World Bank. (2022, May). *State and Trends of Carbon Pricing.* https://openknowledge.worldbank.org/handle/10986/37455

Carbon pricing instruments covering heating fuels are also in place in New Zealand and Switzerland, at the subnational level in Saitana, Japan and in the emissions trading pilot in Beijing, China.[67] It is worth noting that most carbon pricing instruments currently cover electricity and not heating fuels,[68] making heat pump purchases relatively less attractive.

Key benefits

The key benefits relate to the alignment of end-user incentives with environmental policy goals and the potential to use revenues to fund environmental projects. Raising the prices of fossil fuels (and biomass, if applied to multiple pollutants) improves the 'total cost of ownership' of a heat pump, compared with a boiler. It also means that clean heat regulations could meet less resistance on the grounds of cost and heat pump subsidies could be lower.

A tax provides more certainty and visibility for the price, while an ETS provides more certainty over the environmental outcomes. Both can create revenues that can be used to address equity concerns (see potential issues below) and overcome other barriers through complementary policy measures. The use of revenues to support energy efficiency and heat pump installations is particularly important for lower-income households.

Potential issues

Cap-and-trade regimes and energy taxation, whether for environmental purposes or not, are regressive. Poorer households tend to spend a greater share of their disposable income on energy. These households are also less likely to be able to adapt to higher environmental taxes by investing in clean alternative technologies. This makes it essential that accompanying policy measures drive investment in decarbonisation among the most vulnerable households and compensate them financially during the period until their dwelling has been adequately renovated.

Political resistance to environmental taxation, such as the 'yellow vest' protests seen in France,[69] highlights the importance of communication and the careful consideration of the use of revenues. It may necessitate a significant proportion of revenues being redistributed to bill payers. This can be done by lowering other more economically inefficient taxes or through lump sum transfers, thus reducing the scope for using the revenues to support decarbonisation projects. Virtually all Canadian carbon tax revenues are redistributed to consumers in provinces where the revenues are generated.[70]

Key decisions

- How should the public be engaged, given potential opposition to new tax measures?
- What should tax rates be and how should they change?
- How should revenues be allocated?
- When should measures be introduced (ideally when energy prices are coming down)?
- How should trading schemes be set up and who should be covered?

67 World Bank, 2022.

68 OECD. (2021). *Carbon Pricing in Times of COVID-19: What Has Changed in G20 Economies?* https://www.oecd.org/tax/tax-policy/carbon-pricing-in-times-of-covid-19-what-has-changed-in-g20-economies.htm

69 Mehleb, R., Kallis, G. & Zografos, C. (2021, September). A discourse analysis of yellow-vest resistance against carbon taxes, *Environmental Innovation and Societal Transitions, Volume 40.* Pages 382-394, ISSN 2210-4224. https://doi.org/10.1016/j.eist.2021.08.005

70 Government of Canada. (n.d. [b.]). *How carbon pricing works.* https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html

Key policy takeaways

1. Packages of policy are needed.
2. Economics, financial support and bans/standards together.
3. Coordination and communication a must for speed.
4. There are multiple and significant upsides to rapid heat pump progress.

About RAP

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

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Heat Pump Policy Case Studies

Matt Malinowski
December 15, 2022

clasp
Efficient Appliances for People & the Planet

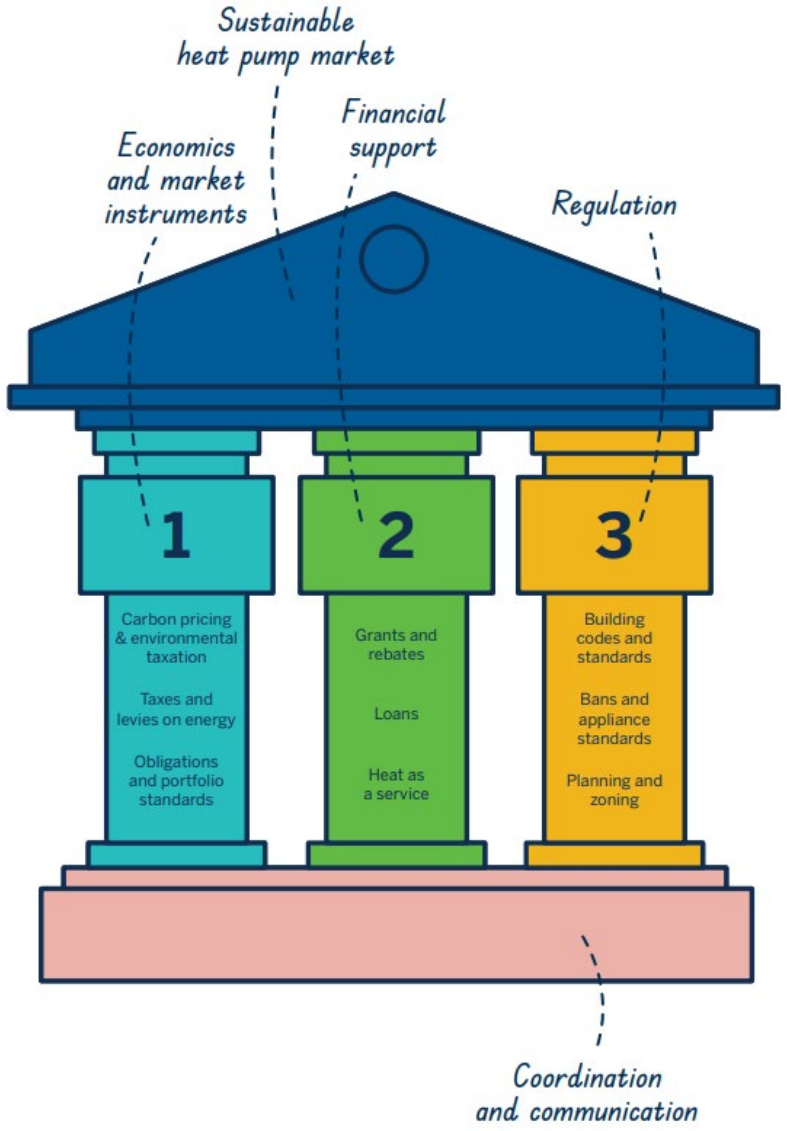
Introduction

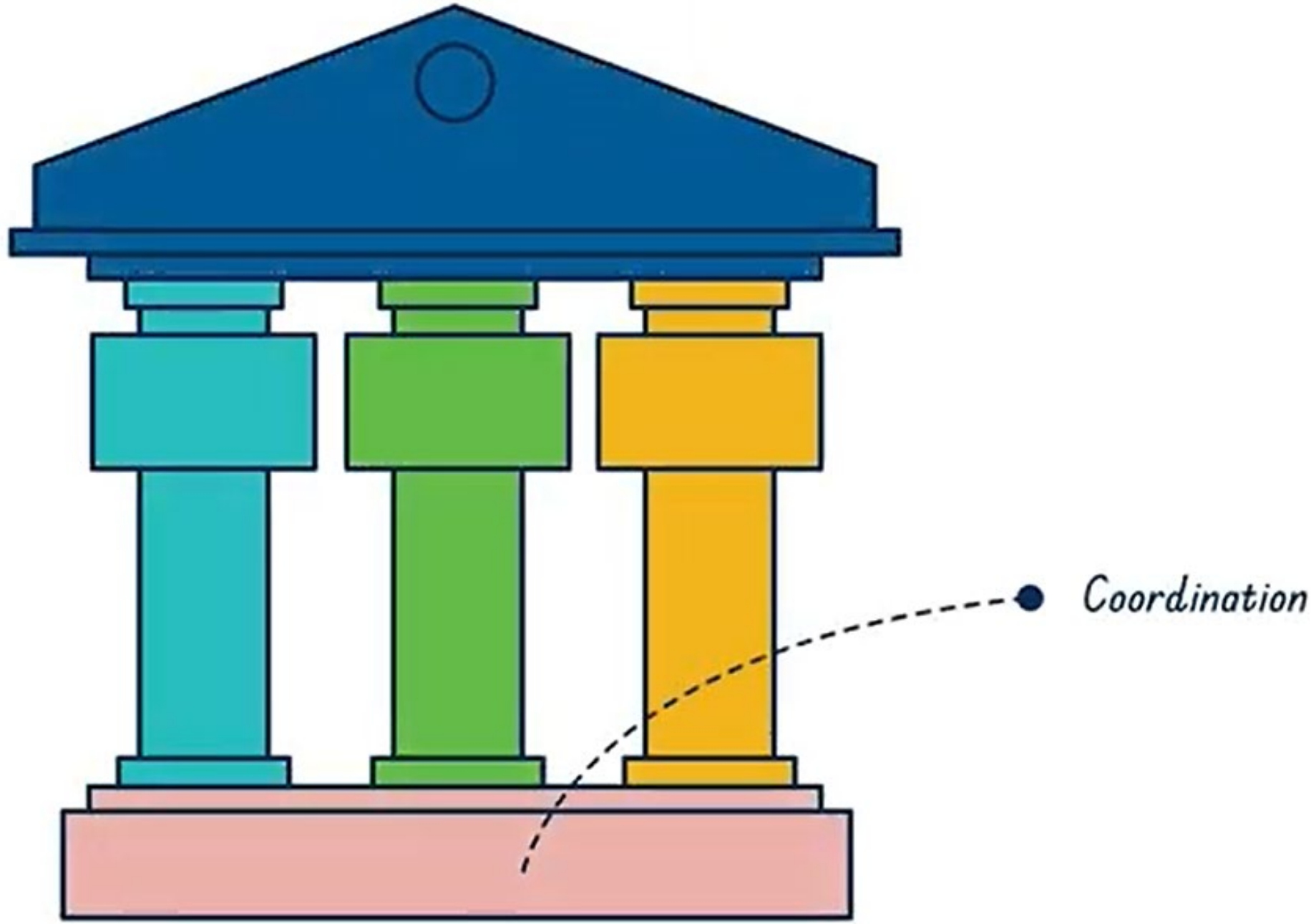
Case studies for each pillar

0. Coordination and communication
1. Economics and market instruments
2. Financial support
3. Regulation

Bringing it all together:

- US Inflation Reduction Act (IRA)

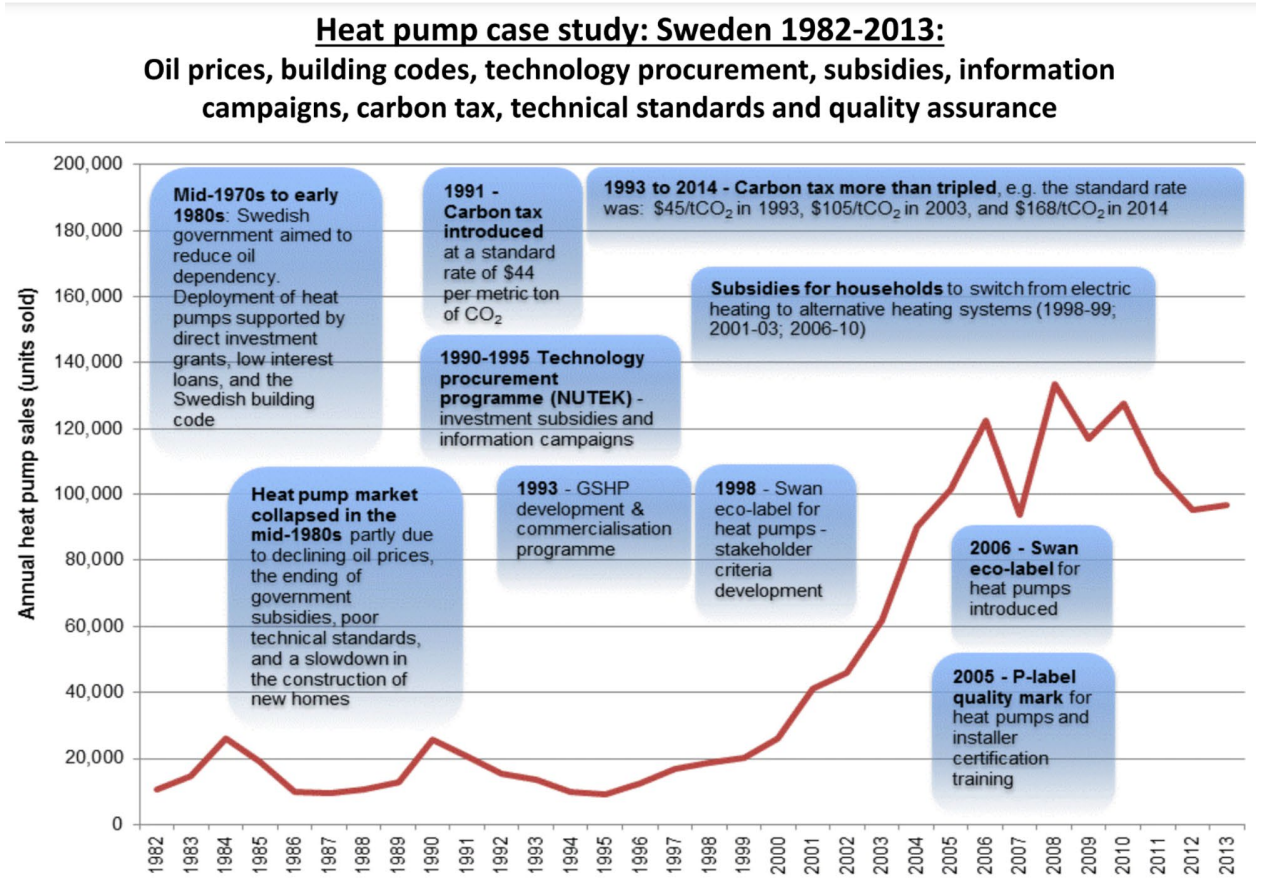



Coordination

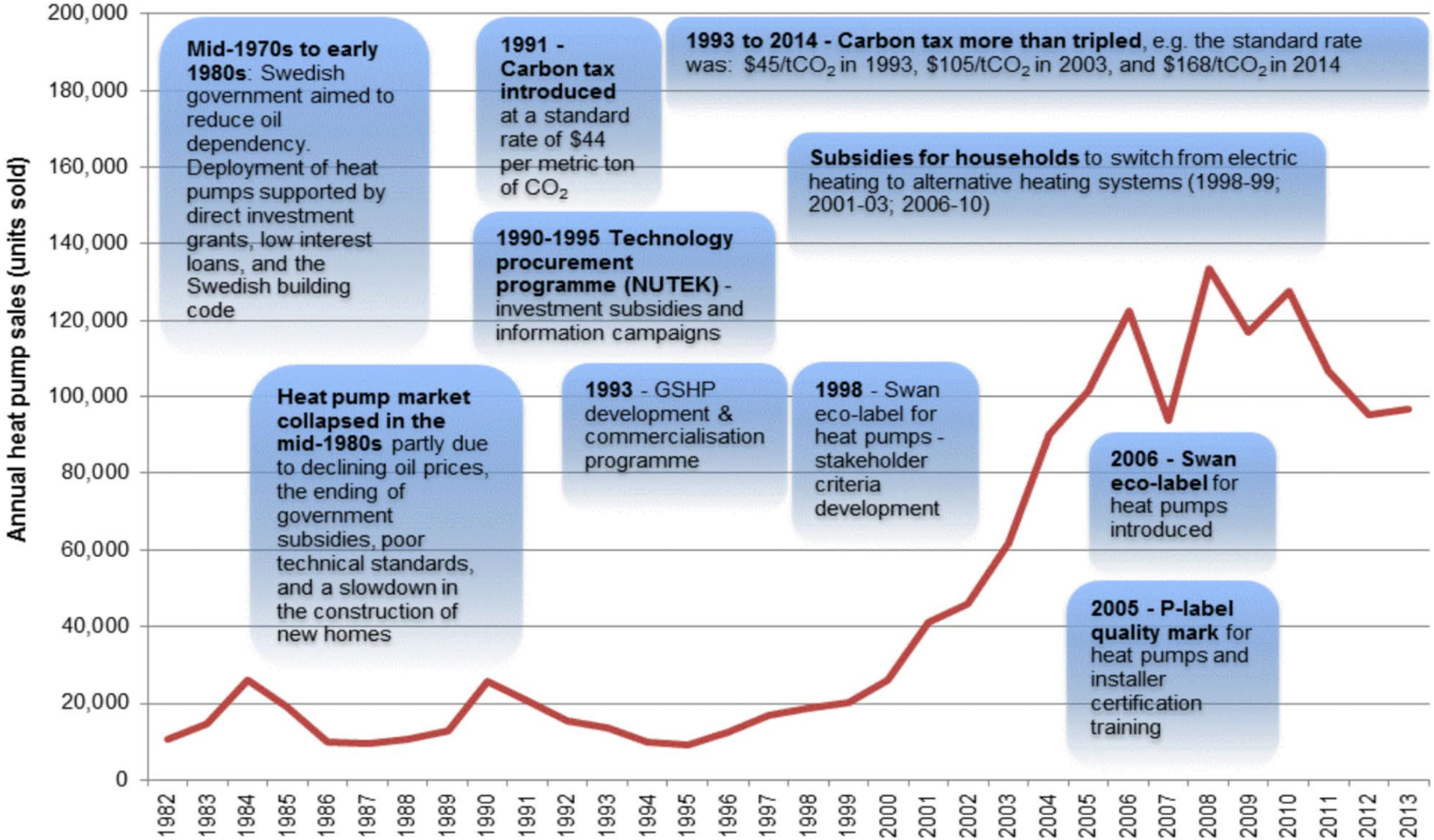
0. Coordination and communication

Coordination

- Market transformation is needed to overcome multiple barriers
- Policy pillars must reinforce each other
- Adjust to changing conditions



Hanna, Richard, Bryony Parrish, and Robert Gross. *Best Practice in Heat Decarbonisation Policy: A Review of the International Experience of Policies to Promote the Uptake of Low-Carbon Heat Supply*, 2016.


Annual heat pump sales (units sold)
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
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2008
2009
2010
2011
2012
2013
Mid-1970s to early 1980s: Swedish government aimed to reduce oil dependency. Deployment of heat pumps supported by direct investment grants, low interest loans, and the Swedish building code
1991 - Carbon tax introduced at a standard rate of $44 per metric ton of CO_2
1993 to 2014 - Carbon tax more than tripled, e.g. the standard rate was: $45/tCO_2$ in 1993, $105/tCO_2$ in 2003, and $168/tCO_2$ in 2014
Subsidies for households to switch from electric heating to alternative heating systems (1998-99; 2001-03; 2006-10)
1990-1995 Technology procurement programme (NUTEK) - investment subsidies and information campaigns
Heat pump market collapsed in the mid-1980s partly due to declining oil prices, the ending of government subsidies, poor technical standards, and a slowdown in the construction of new homes
1993 - GSHP development & commercialisation programme
1998 - Swan eco-label for heat pumps - stakeholder criteria development
2006 - Swan eco-label for heat pumps introduced
2005 - P-label quality mark for heat pumps and installer certification training

0. Coordination and communication

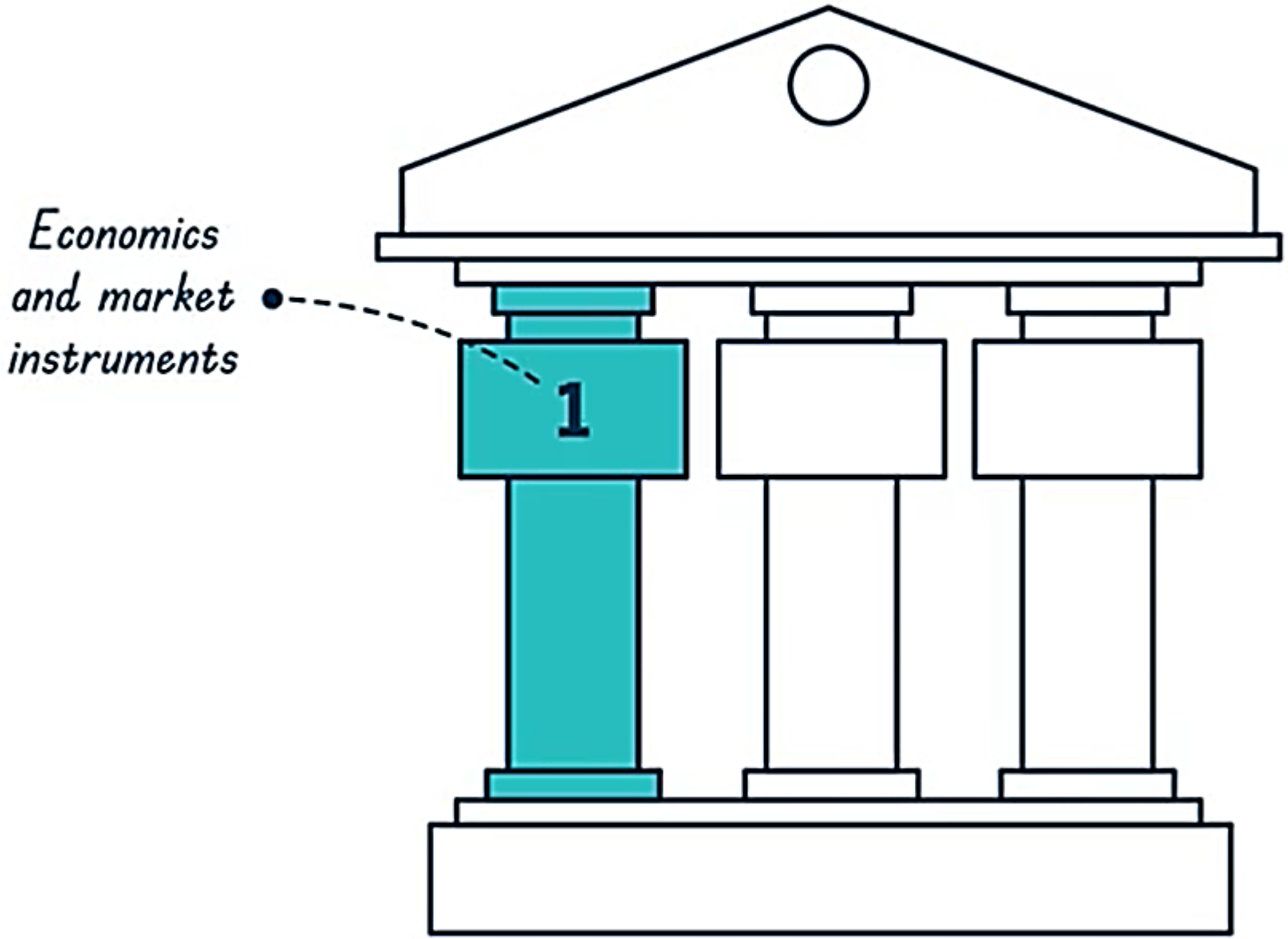
Communication

- Informing beneficiaries about policies
- Building trust and demand among consumers and installers
- Troubleshooting problems

1993: Sweden launched procurement campaign

- Sales doubled 1995–1996
- 50% of budget spent on communication

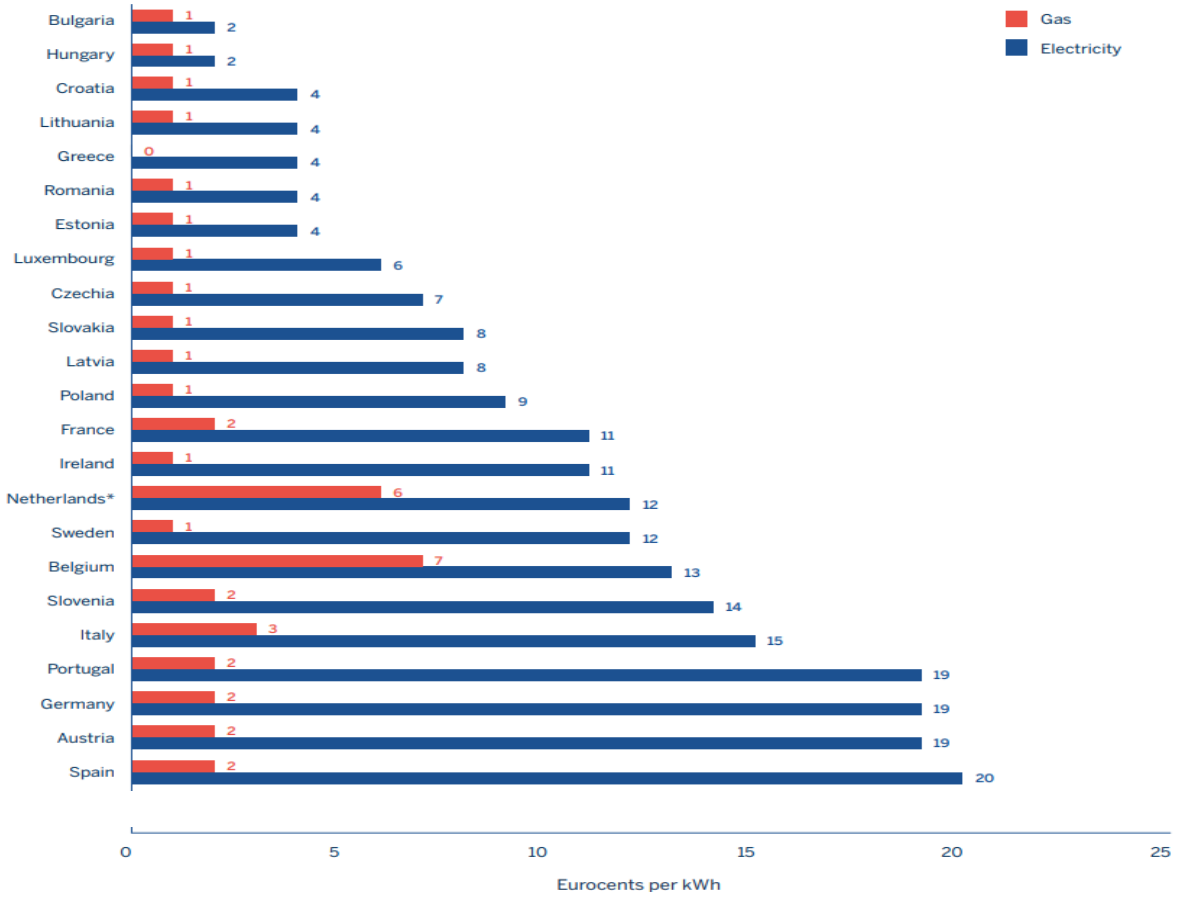
Kiss, Bernadett, Lena Neij, and Martin Jakob. “Heat Pumps: A Comparative Assessment of Innovation and Diffusion Policies in Sweden and Switzerland.” In *Energy Technology Innovation: Learning from Historical Successes and Failures*, edited by Arnulf Grubler and Charlie Wilson, 118–32. Cambridge: Cambridge University Press, 2013.

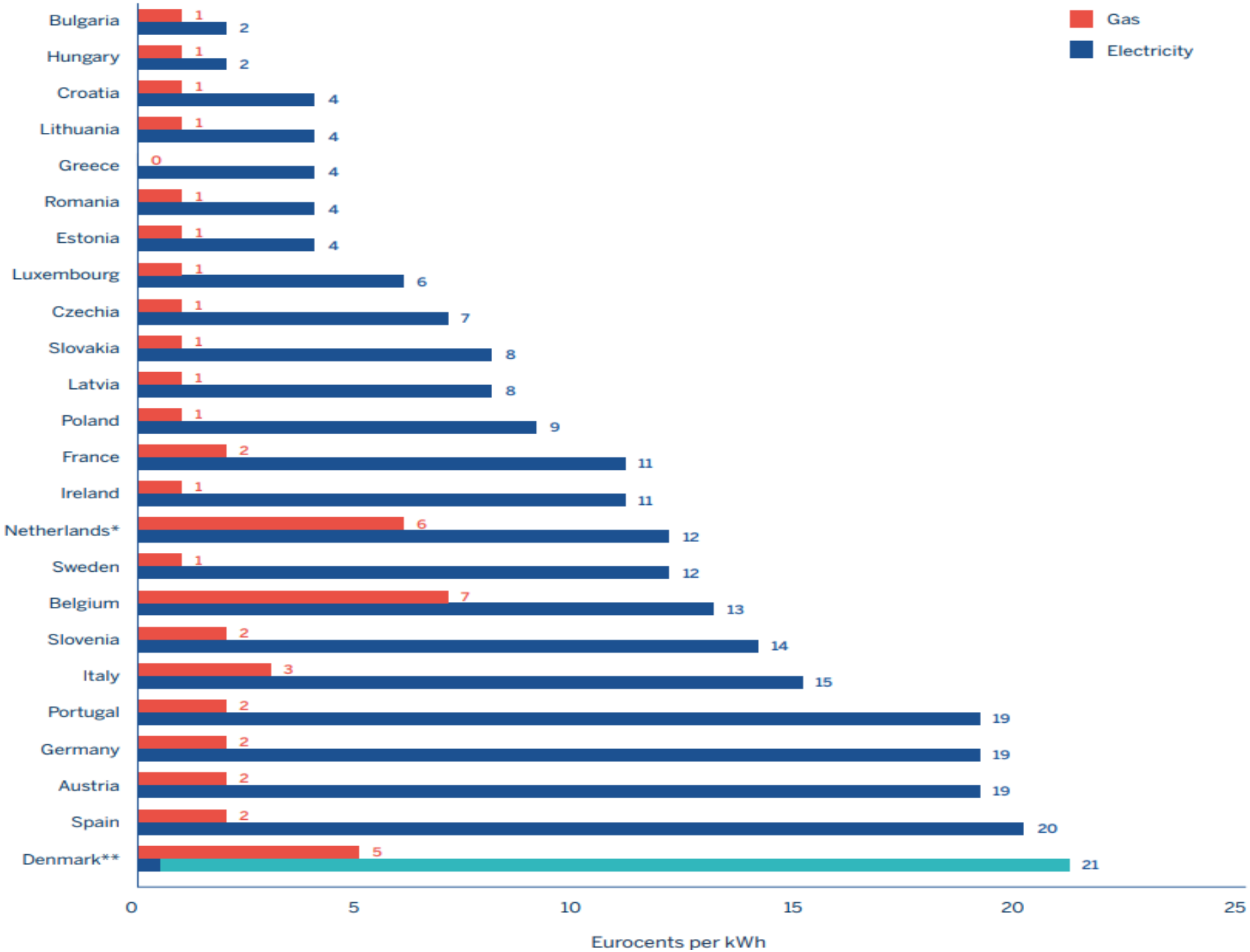

Economics
and market
instruments
1

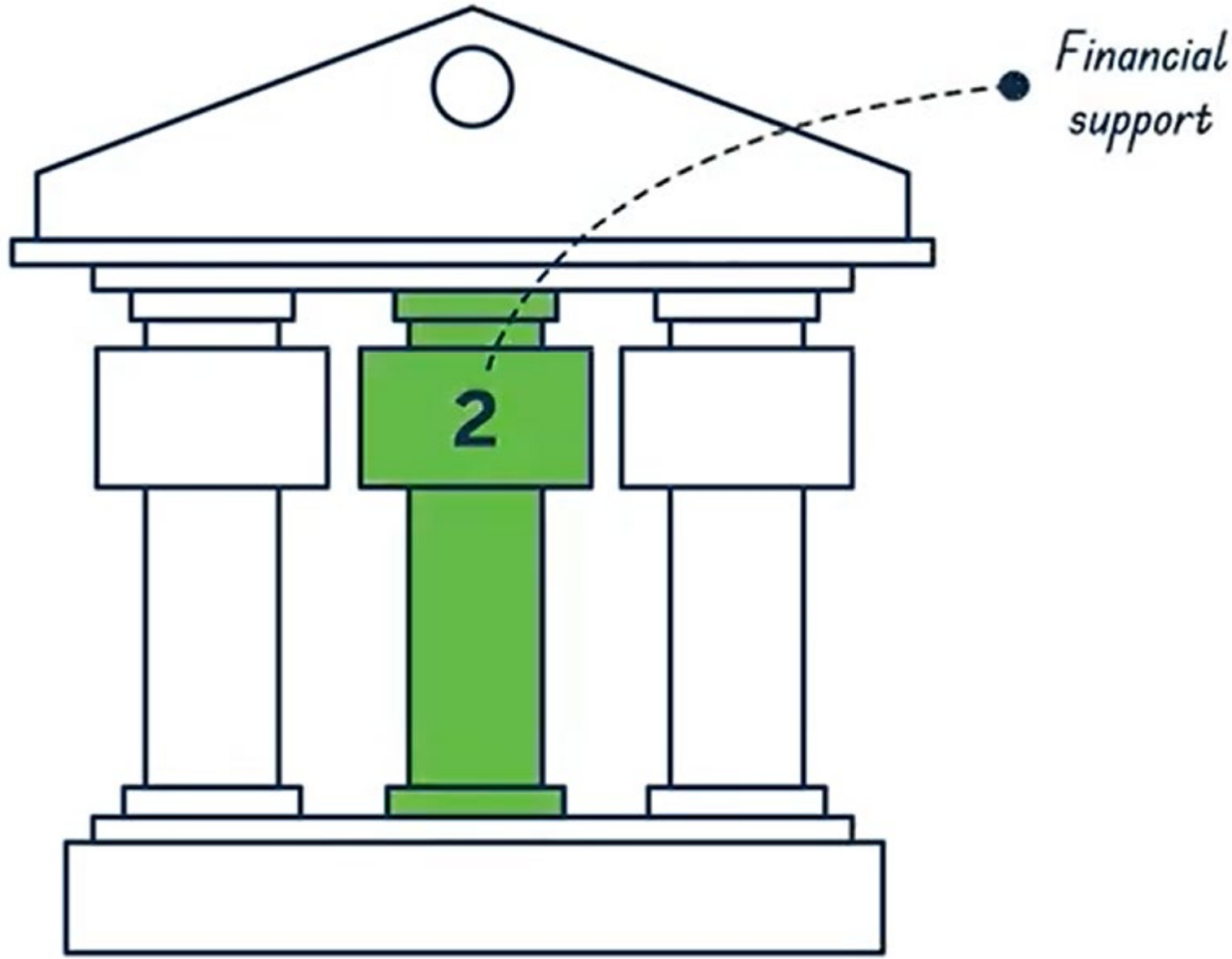
1. Economic and market instruments

Reducing <u>operating</u> costs of heat pumps

- Bringing equity to gas versus electric rates/tariffs
- CO_2 tax




Gas
Electricity
Bulgaria 1 2
Hungary 1 2
Croatia 1 4
Lithuania 1 4
Greece 0 4
Romania 1 4
Estonia 1 4
Luxembourg 1 6
Czechia 1 7
Slovakia 1 8
Latvia 1 8
Poland 1 9
France 2 11
Ireland 1 11
Netherlands* 6 12
Sweden 1 12
Belgium 7 13
Slovenia 2 14
Italy 3 15
Portugal 2 19
Germany 2 19
Austria 2 19
Spain 2 20
Denmark** 5 21
0
5
10
15
20
25
Eurocents per kWh


Financial support
2

2. Financial support

Reducing up-front/purchase costs of heat pumps

- Rebates
- Personal tax credits
- VAT/sales tax

UK rebate

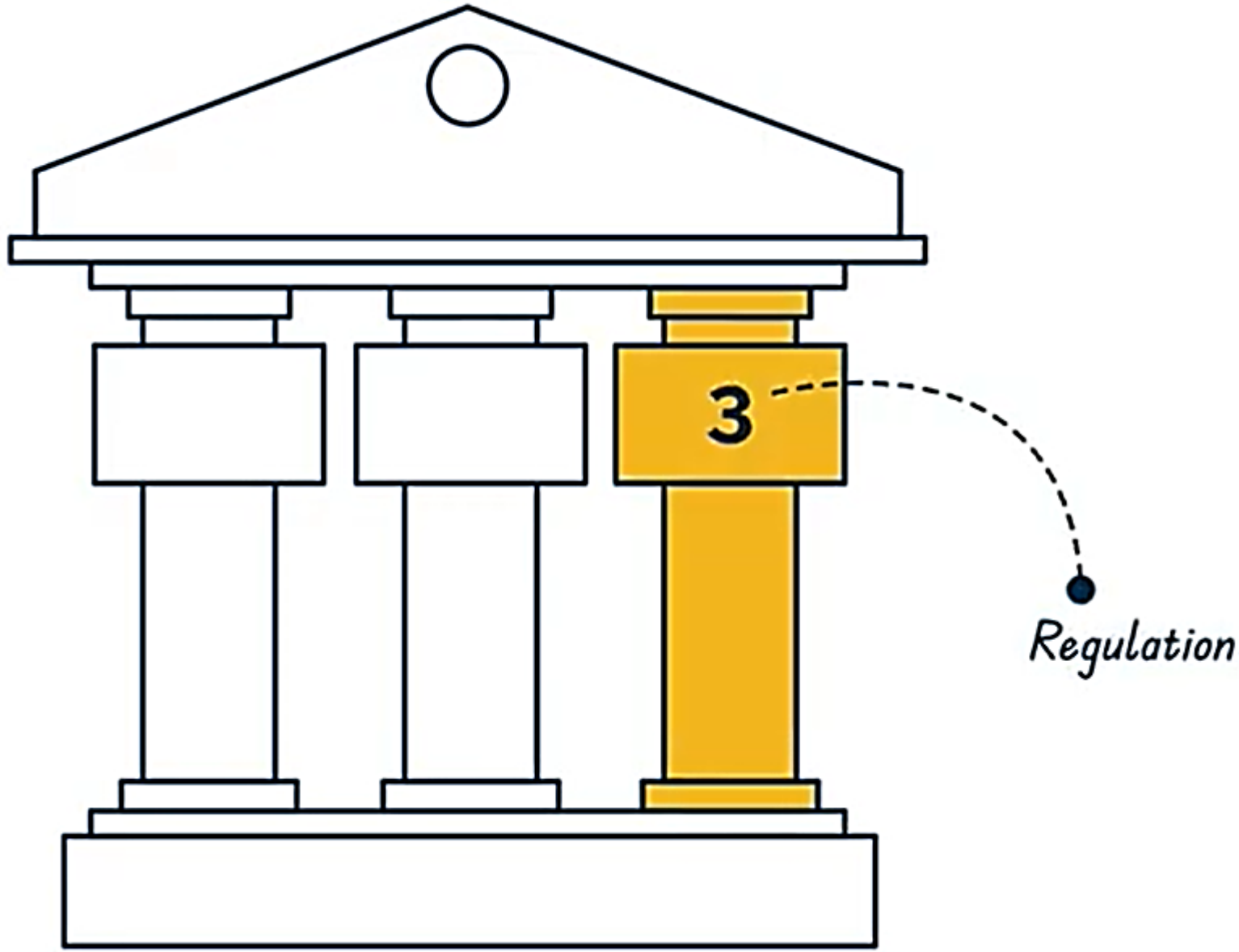
- Air-/ ground-source:
  GBP 5,000-6,000
- Paid to installer

Ofgem. (n.d.). Boiler upgrade scheme (BUS). https://www.ofgem.gov.uk/ environmental-and-social-schemes/boiler-upgrade-scheme-bus

Italy “Superbonus”

- 110% of installation costs

Sunderland, L. & Segura, L., eds. (2022, September). The Energy Poverty Handbook. The Greens/EFA in the European Parliament.

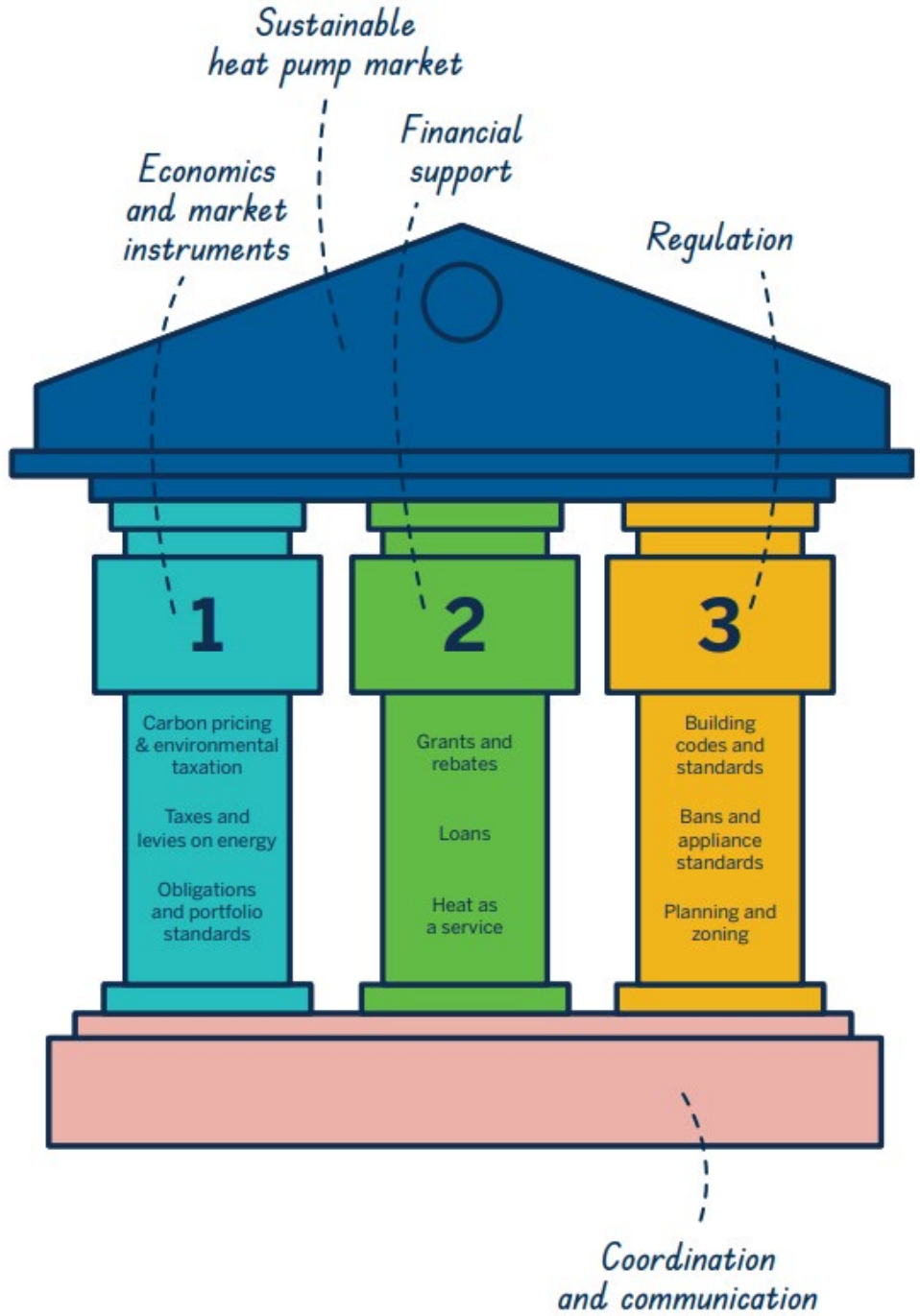

3
Regulation

3. Regulation

Regulation works where voluntary policies cannot

- Once path is clear, regulations can help transition rest of the market
- Bans or stringent standards for fossil fuels or one-way ACs
- Efficiency or quality standards for heat pumps

- In Japan, all air conditioners also provide heat (reversible)
  - Japan Annual Performance Factor (APF) requirement
  - Main source of heat


Sustainable heat pump market
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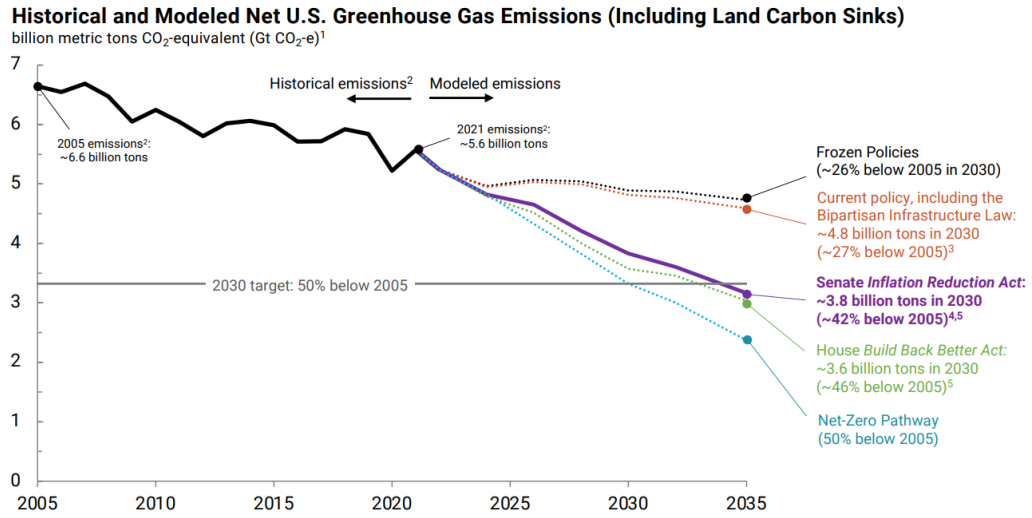
Grants and rebates
Loans
Heat as a service
Building codes and standards
Bans and appliance standards
Planning and zoning
Coordination and communication

Bringing it all together: US Inflation Reduction Act

Signed into law in August 2022

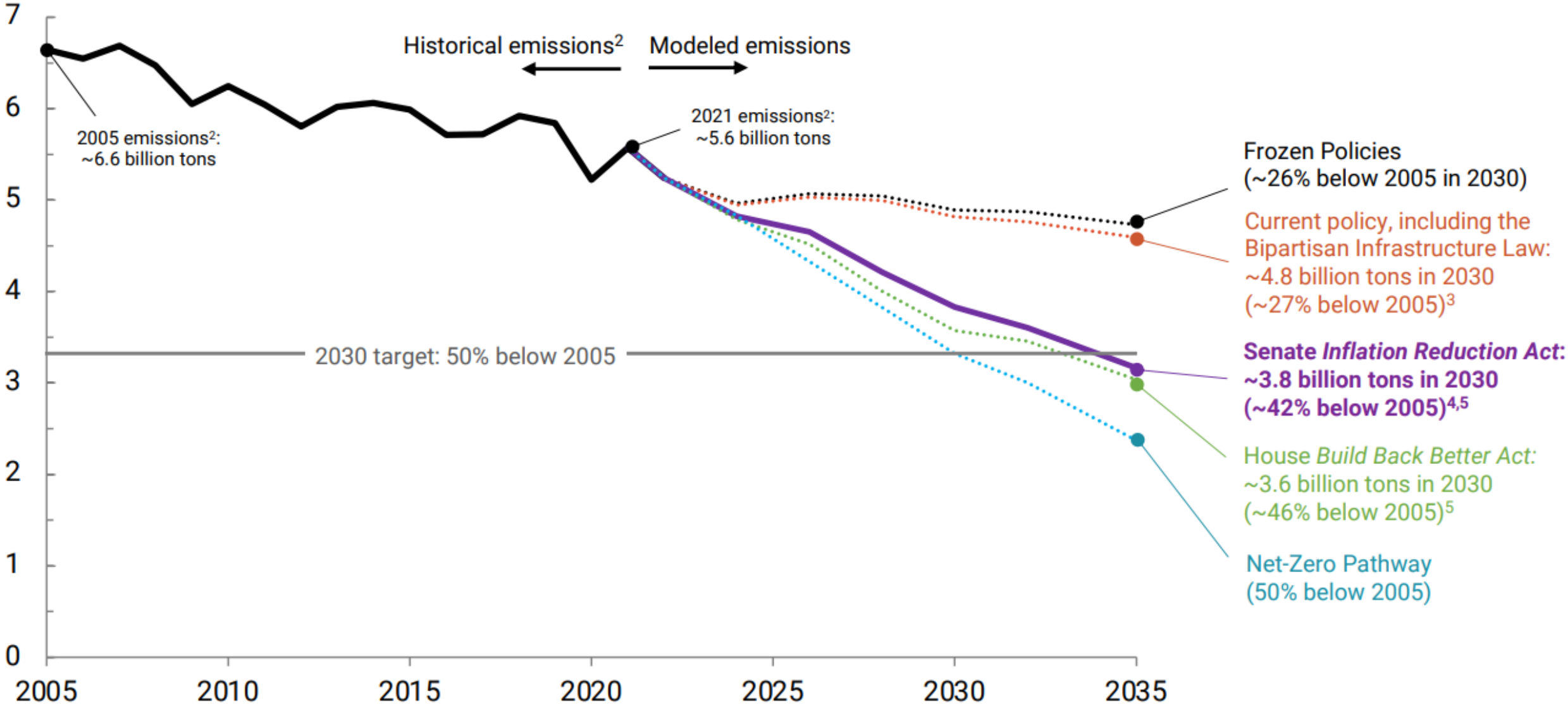
- $369 billion in energy and climate spending
- Significant portion for building electrification/heat pumps



Jenkins, J.D., Mayfield, E.N., Farbes, J., Jones, R., Patankar, N., Xu, Q., Schivley, G., “Preliminary Report: The Climate and Energy Impacts of the Inflation Reduction Act of 2022 ,” REPEAT Project, Princeton, NJ, August 2022.

Historical and Modeled Net U.S. Greenhouse Gas Emissions (Including Land Carbon Sinks)

billion metric tons CO_2-equivalent (Gt CO_2-e)[1]



0. Coordination and communication

Coordination

- No single agency in charge of funding
- Coordination at community level
  - State Energy Offices
  - Non-profit organizations

Communication?

- Demonstration and deployment

1. Economic and market instruments

Reducing operating costs of heat pumps

- Nothing in the law directly addresses gas/electric rates, CO_2 taxation
- Tax incentives for solar PV & storage

2. Financial support

Reducing up-front/purchase costs of heat pumps

- Annual 30% or $2000 tax credit for heat pump or heat pump water heater + related upgrades
- Rebate for low- and middle-income households
  - $4000-8000 for heat pump

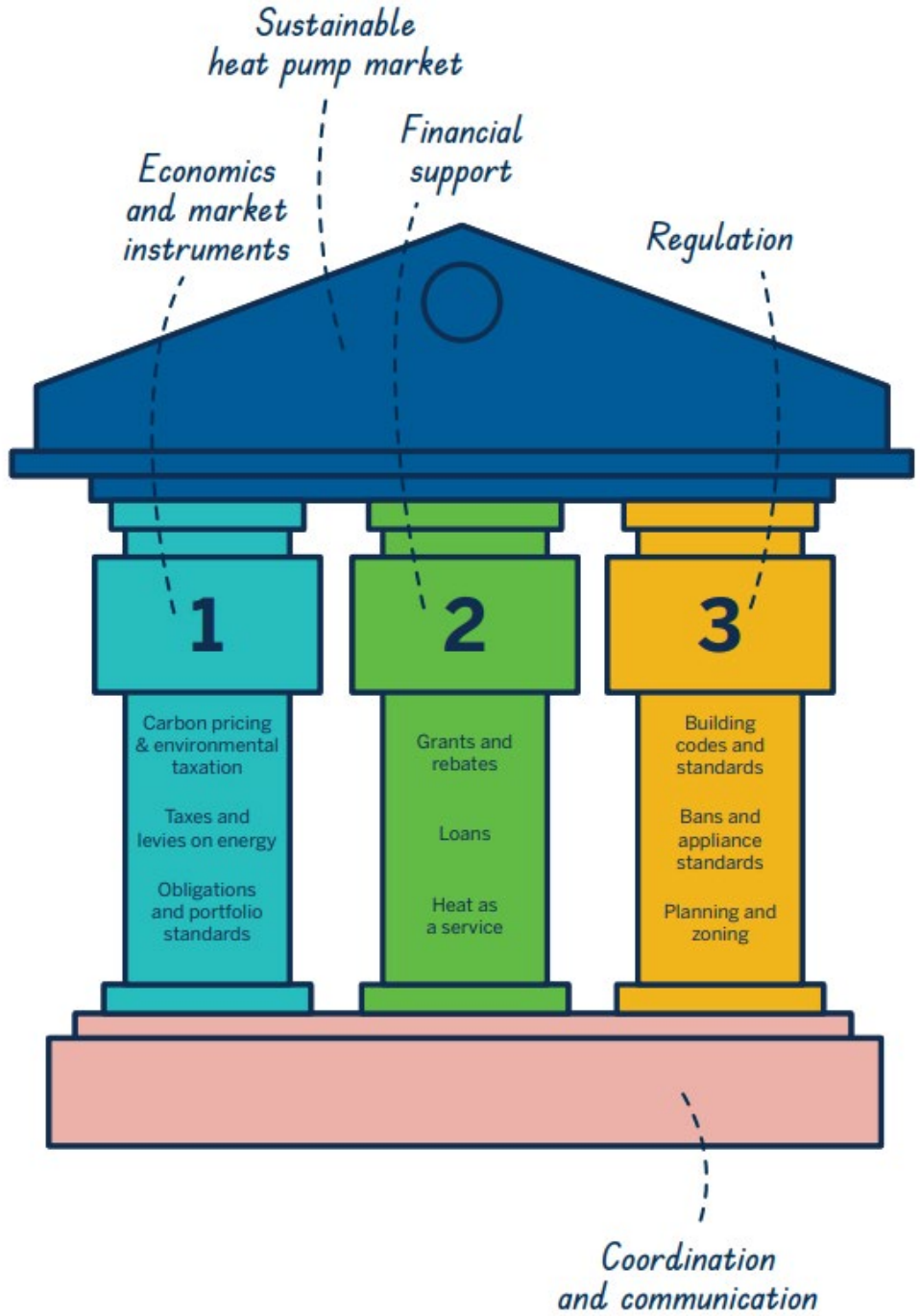
- >$30 billion for State Energy Offices and non-profit organizations
  - Energy reduction, zero-emission technology, greenhouse gas reductions
  - Not necessarily heat pumps

3. Regulation

Regulation works where voluntary policies cannot

- $330 million for adopting 2021 IECC or equivalent
- $670 million for adopting zero-energy codes

- Product standards outside of IRA
  - Would shift some sales to heat pumps


Sustainable heat pump market
Financial support
Economics and market instruments
Regulation
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Carbon pricing & environmental taxation
Taxes and levies on energy
Obligations and portfolio standards
Grants and rebates
Loans
Heat as a service
Building codes and standards
Bans and appliance standards
Planning and zoning
Coordination and communication

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