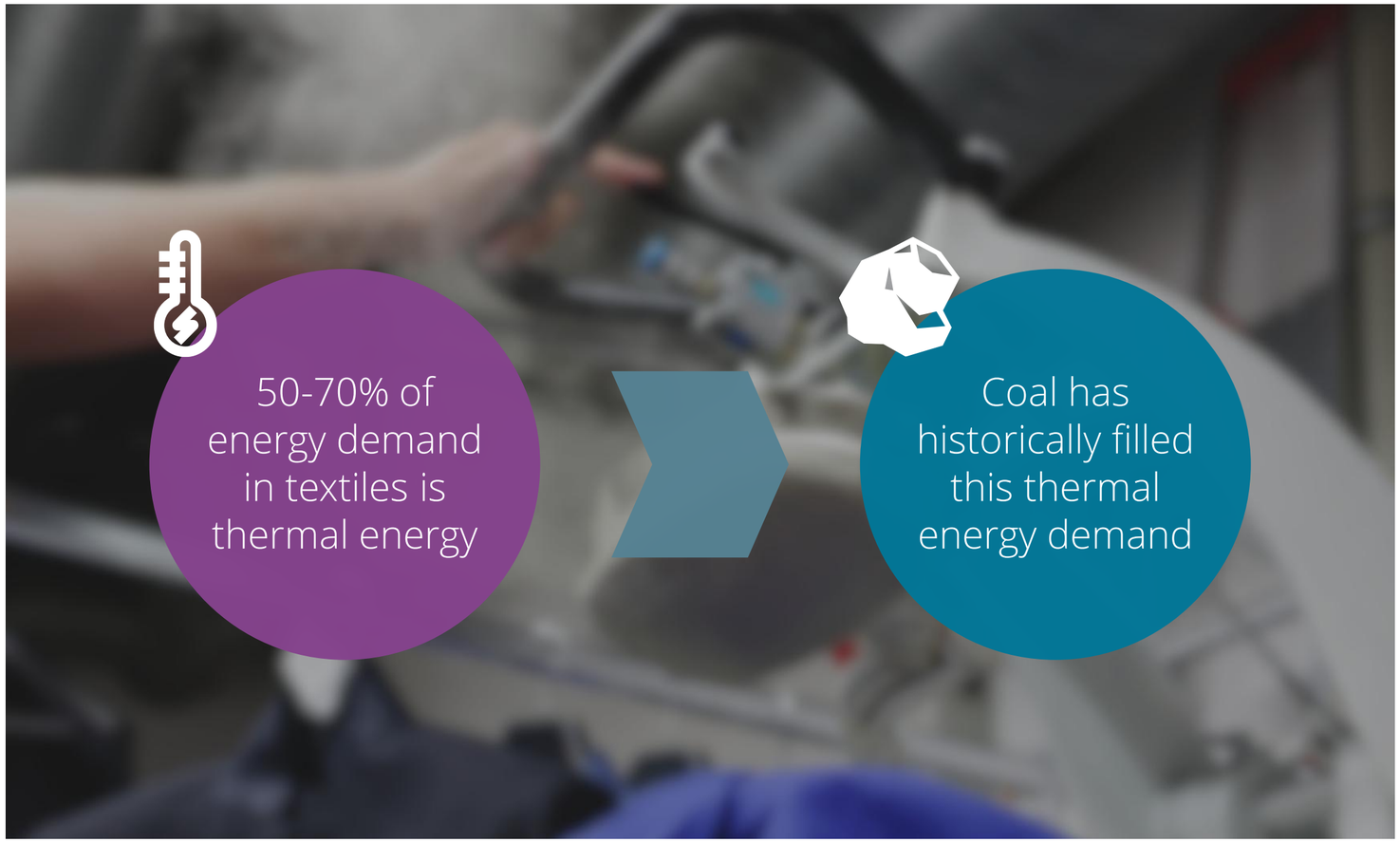
Promoting water stewardship and taking action against climate change and biodiversity loss throughout H&M Group's value chain and beyond

Electrifying the Textile and Apparel Sector in Vietnam

CONTENTS

THERMAL ENERGY REPRESENTS OVER HALF OF ENERGY DEMAND IN THE TEXTILE & APPAREL (T&A) INDUSTRY



THERMAL ENERGY IS USED TO MAKE HOT WATER AND STEAM, USED FOR:

- Dyeing
- Washing
- Bleaching
- Mercerising
- Rinsing

- Steam fixation
- Finishing
- Heat setting
- Ironing
- Shrinkage Control

MANY BRANDS, INCLUDING H&M GROUP, HAVE COMMITTED TO PHASE OUT COAL WITHIN THEIR SUPPLY-CHAINS

Fashion for Climate
Fashion Industry Charter for Climate Action

80+ apparel groups have signed the **UNFCCC Fashion Industry Charter for Climate Action**, which includes commitments to:

- No new coal power by January 2023, and
- Phase out coal as soon as possible but at the latest by 2030.

Example signatories of the UNFCCC Fashion Charter

H&M Group, leading the industry transition, has committed to:

- No new coal by January 2022
- Phase out coal from our garment supply chain (tiers 1, 2 and 3) by 2026

H&M Group

RICE AND WOOD-BASED BIOMASS ARE INCREASINGLY BEING USED TO SUBSTITUTE COAL IN VIETNAM. BUT BIOMASS ALSO HAS MULTIPLE RISKS

Common biomass fuels in Vietnam

Biomass downsides

1. **Increased pressure on supply leading to price volatility**
2. **High Biogenic CO2 Emissions**
3. **Local air pollution impacts similar to coal**
4. **Low traceability, and certified biomass expensive**

See later slides for more analysis

GLOBAL EXPERTS AGREE THAT TO KEEP 1.5º COMMITMENT, LOW-HEAT INDUSTRIES MUST ELECTRIFY. H&M GROUP ALSO PLANS TO ELECTRIFY PROCESS HEAT

Major organizations support a shift to electrifying low-temperature heat…

NRDC
NATURAL RESOURCES DEFENSE COUNCIL

Decarbonization: Why We Must Electrify Everything Even Before the Grid Is Fully Green

April 2020
McKinsey Quarterly

By 2030, more than 90 percent of the abatement for mid- to low-temperature industries depends on electrifying production with power sourced from clean-energy sources.

apparel impact institute

Electrification technologies, when tied to renewable electricity, have the best potential to decarbonize the textile industry.

…including H&M Group

H&M Group

Climate Transition Plan

"**Transitioning from thermal energy to electricity in production** is key to reaching our goals [….] " there is a need to decarbonise heating for current processes **by using heat pumps,** or by adding hot-water storage solutions to reduce energy requirements."

COMPARED WITH BIOMASS BOILERS, ELECTRIC OPTIONS, LIKE HEAT PUMPS, ARE MORE EFFICIENT, CLEANER, BUT CAN BE HARDER TO INTEGRATE, AND MAY HAVE A LOW ROI

Analysis of biomass vs electrification

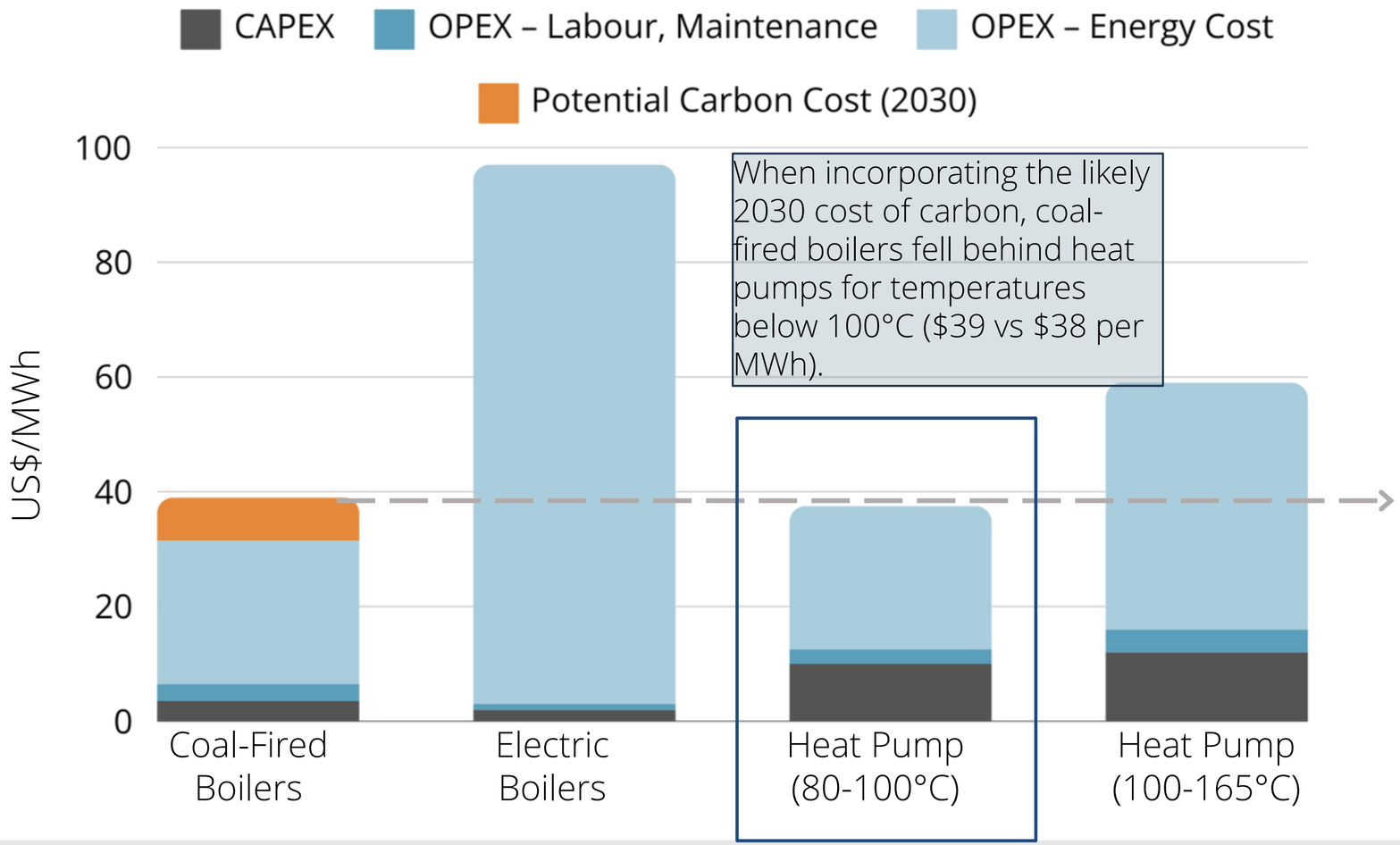
	Efficiency and Performance	Maintenance & Operation	Air pollution	Greenhouse Gas Emissions	Integration & Complexity	Return on investment
Biomass Boiler	50 - 90% thermal efficiency; slower response time	Require fuel transport, storage, management, regular maintenance.	Similar air pollution levels / negative health outcomes to coal boilers	When bioenergic emissions counted, can be high	Simple (substitution of current process)	Low CAPEX, cheap biomass in current market
Electrification Options	Close to 100% thermal efficiency; faster response time	Rely on electricity so much less physical effort; cleaner work environment.	Zero local air pollution	Zero total emissions IF using RE	Requires integration of new machinery and likely process flow	High investment cost, low Return on Investment

MAIN BARRIER

Key: Great, Good, Fair, Challenging

HOWEVER, HEAT PUMPS ARE BECOMING COMPETITIVE FOR LOWER HEATING TEMPERATURES AND H&M GROUP SUPPLIERS IN CHINA ARE NOW INSTALLING THEM

Levelised Cost of Industrial Heat Production (2021)



Heat pump in H&M Group China suppler

Source: Energy Innovation (2024)

DIFFERENT ELECTRIFICATION OPTIONS EXIST IN THE TEXTILE SECTOR, FROM HEAT PUMPS TO THERMAL STORAGE

1

Source: Yuanda boiler

Centralised
Electric Boiler

2

Source: GEA heat pump

Centralised
Heat Pump

3

Source: Enerteam

Decentralised systems (end-use process electrification)

4

Solar Thermal

5

Source:

Thermal storage

A combination of these technologies is likely to be optimal

AMONG THESE, HEAT PUMPS ARE MORE EFFICIENT BUT HAVE HIGHER CAPEX AND REQUIRE INTEGRATION. DECENTRALISED SOLUTIONS ARE ALSO PROMISING

Different electrification types and their benefits. Sample costs from one small H&M factory in Vietnam

		Integration & Complexity	CAPEX	OPEX (electricity cost per year)	Main Benefits	Challenges
0	**Biomass**		**100K**	**90K**	Business as usual	Environmental integrity, price volatility
1	**Electric Boiler**		**88K**	**99K**	Easy to integrate into existing systems; Can turn down during low use	Expensive electricity
2	**Heat Pump**		**440K***	**59K**	Highly efficient	Best with steady process load
3	**Decentra-lised**		**170K**	**68K**	Highly modular (can turn off and on).	Requires production changes
4	**Solar Thermal**		**N/A**	**~0 electricity cost**	No electricity costs	Requires large space
5	**Thermal Storage**		**N/A**	**Dependent on tariffs**	Take advantage of low electricity prices	Requires very large

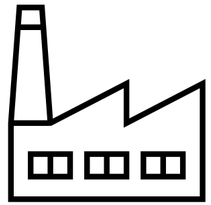
Key: Great, Good, Fair, Challenging

*Does not include installation and electricity upgrade investments

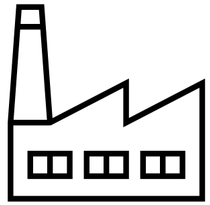
Source: Enerteam analysis of tier 1 1 factory

WWF AND H&M GROUP HAVE WORKED WITH 3 FACTORIES IN VIETNAM TO BETTER UNDERSTAND THE FEASIBILITY OF ELECTRIFICATION SOLUTIONS

Factories studied



A



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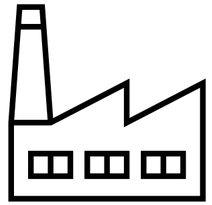


C

	A	B	C
Activities	Jersey, cutting, sewing, ironing	Cutting, sewing, ironing	Dying, washing, cutting, sewing
Heat processes	**Ironing only**	**Ironing only**	**Dying and Laundry**
Fuel type	Wood pellets	Wood logs & Sawdust briquettes	Wood logs
Annual Fuel Use	**700 tonnes**	**1,120 tonnes**	**1,376 tonnes**

WWF also looked at one non-H&M Group Tier 2 supplier. This study is ongoing

FROM A TECHNICAL AND REGULATORY STANDPOINT, ELECTRIFICATION SOLUTIONS ARE FEASIBLE ACROSS ALL SITES VISITED…

Analysis of 3 sites

	Technology	Technology feasibility	Regulatory feasibility	Site feasibility
1	**Electric Boiler**	☑	☑	☑
2	**Heat Pump**	☑	☑	☑
3	**Decentralised***	☑	☑	☑

** SOLUTIONS not studied in C as multiple heat processes*

4	**Solar thermal**	Not studied due to temperature and space limitations
5	**Thermal Storage**	Not studied as off-peak tariff in Vietnam not sufficiently low.

AND, FROM A BIOGENIC EMISSIONS PERSPECTIVE THESE TECHNOLOGIES SAVE CO2….

Analysis of carbon emissions

Facility	Current emissions (biogenic - ton of CO2e)	High efficiency heat pump* using grid electricity	Heat pump emissions using green electricity	Electrification Emissions reductions without green electricity	Emissions reductions with green electricity
A	1,021	357	0	**664**	**1,021**
B	2,049	766	0	**1,283**	**2,049**
C	2,554	1,190	0	**1,364**	**2,554**

Even without green electricity, electrification technologies result in a fall in emissions.

With carbon-free electricity, this is improved further.

All locations in the study use biomass, so biogenic emissions are being counted in the comparison. If only count non-biogenic emissions counted, then emissions reductions will be neutral

DECENTRALISED SOLUTIONS HAVE A SMALL POSITIVE IRR, WHICH INCREASES IF BIOMASS PRICES INCREASE. FOR HEAT PUMPS, THERE IS A POSITIVE PAYBACK, BUT ONLY AFTER 6-8 YEARS

Findings of in-factory study

	MAIN TECHNOLOG(IES) SUGGESTED	NPV (COMPARED TO CURRENT BIOMASS PRICES)	POST TAX IRR	POST TAX IRR (50% increase in biomass price)	Additional cost per unit (current biomass prices, NPV)*
 A	Decentralised ironing	-$10,450	6.78%	**64.5%**	**+$0.002**
	Heat pump	**-$209,182**	**-7.94%**	**10.6%**	**+$0.003**
 B	Decentralised ironing	- 25, 621	5.81%	**50.4%**	**+$0.024****
 C	Heat Pump	8 year payback		6 year payback	

**Cost per unit alculated over 8 years rather than technology lifetime of 15*

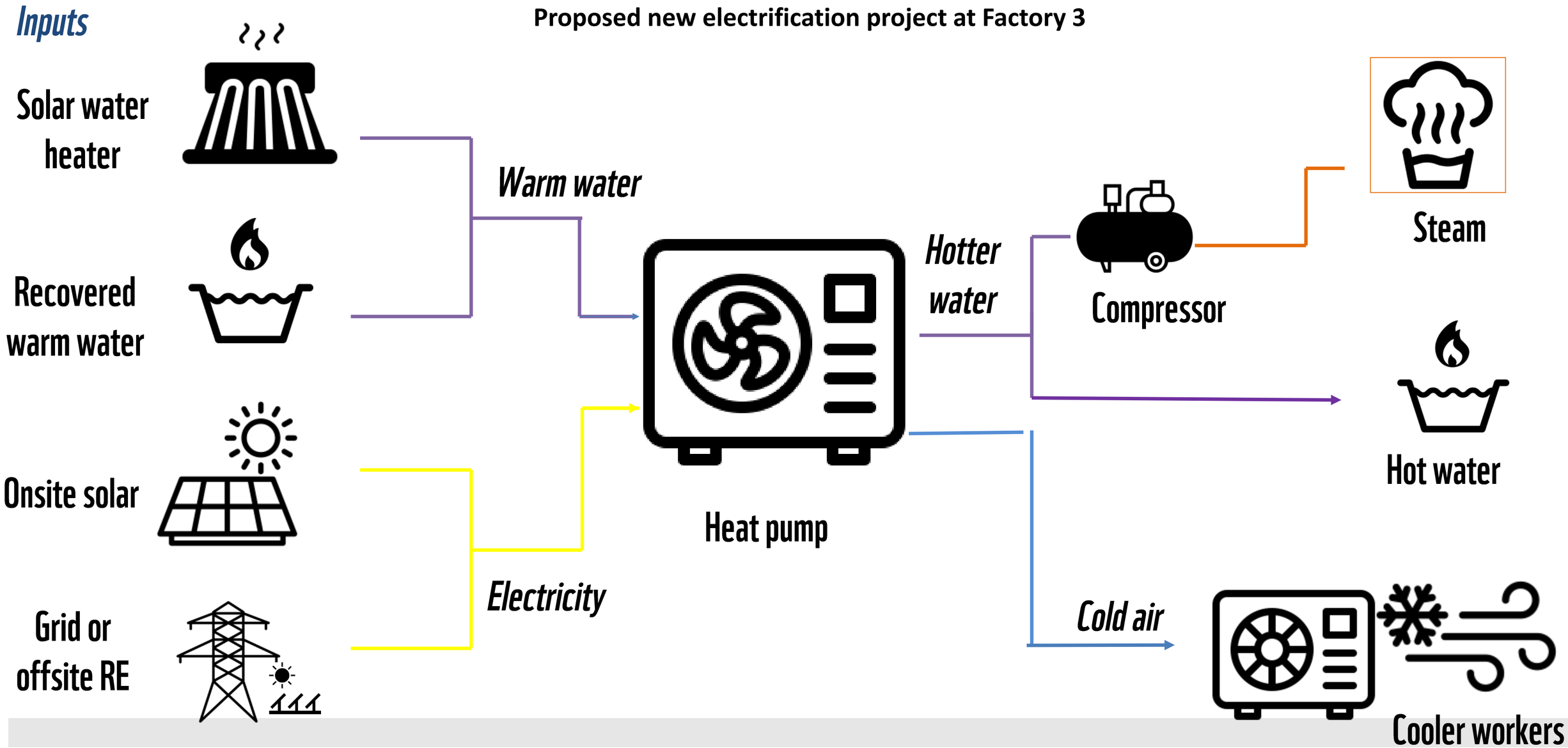
***higher cost as suit is main output*

THERE ARE DRIVERS OF LOW PROFITABILITY OF ELECTRIFICATION WHICH MAY CHANGE IN THE NEAR FUTURE

Reasons why electrification economics may improve

- Low cost of current uncertified biomass (as low as $0.07 per kg), but this may rise as demand increases
- High loan interest rates (~10%), but there are new projects emerging to lower finance costs
- Safety and health externalities not priced into cost of biomass
- Cheaper electricity through on-site renewables / PPAs not considered, but new DPPA legislation is emerging
- CAPEX of biomass boiler (BAU) priced as $0 (already installed). Where a factory must replace, economics may be better
- Fall in cost of heat pumps and electric boilers, as more industries use them

WITH ONE FACTORY, H&M GROUP AND WWF ARE PROPOSING AN AMBITIOUS INTEGRATED HEAT PUMP PROJECT



TO FURTHER SUPPORT THE GREEN TRANSITION IN VIETNAM AND ENSURE THE RIGHT REGULATORY CLIMATE, A JOINT APPROACH ON PUBLIC AFFAIRS IS NECESSARY.

KEY POLICIES TO WORK ON FOR THE GOVERNMENT

Policies to accelerate access to affordable green electricity

- **DPPAs -** Develop clearer guidelines and regulations around DPPA especially for IP zones
- **Clear Feed-in-tariffs** for unused on-site renewable energy , building on New decree 135/2024/ND-CP (October 2024)
- **Battery Storage –** Expedite energy storage solutions with clearer guidelines
- **More variable tariffs during low-peak times**
- **VAT rates on electrification solutions**

Policies that account for externalities of biomass

- **Regulation on air pollution standards** that make biomass less competitive
  - e.g. in China, biomass is rarely used in textiles
  - TEDD - Transparent Environment Data Disclosure* being developed, expected 2026
- Increased efforts to ensure **traceability of biomass**
- **Pricing on coal** such as a **carbon tax** or industry phase-outs, would also lead to rising biomass demand/prices

WWF and H&M Group, in collaboration with other organisations, would work together on developing a policy engagement strategy for Vietnam, to work on the above priority issues

*an initiative supported by IDH, enabling real-time monitoring of environmental data in factories and industrial parks.

CONCLUSION

Textile and apparel factories have relied on coal for process heat, but recently have been switching to biomass. However, biomass poses risks from GHG and local emissions, price volatility, and traceability concerns.

In three H&M Group factories in Vietnam, electrification solutions such as electric boilers, heat pumps, and decentralized solutions are technically feasible and result in cleaner, safer, and low-carbon heat if combined with green electricity.

According to our first analysis, decentralized ironing solutions are likely cost neutral (positive IRR, but negative NPV, given high interest rates) compared to the current biomass option.

Heat pumps, if they replace fully the existing heat supply from biomass boilers, are likely to be negative, given the required investment costs. However, if we re-think processes, there may be ways to decrease the cost and make it economically viable. We are waiting for one such study. Increased cost per unit is relatively low, as little as $0.001 per piece. Additionally, with rising biomass prices, heat pumps may become more competitive.

Given the importance of electrification of light industry for climate change mitigation, as well as positive health and safety outcomes, brands and manufacturers should push now for increased use of electrified solutions.

ANNEX

BIOMASS RISKS: BIOMASS HAS ENVIRONMENTAL, SOCIAL, AND ECONOMIC RISKS, INCLUDING ON GREENHOUSE GAS EMISSIONS

1

Global Warming Effects

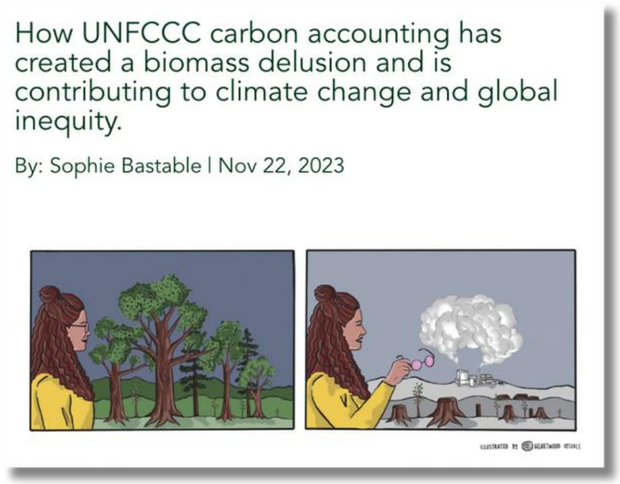
CO2 emissions from burning biofuels tend to be ignored within carbon accounting due to the assumption they are biogenic.

This ‘net-zero’ claim is debated: both coal and biomass emit comparable levels of CO2 when burned, and reabsorption by future vegetation is not guaranteed.

SUSTAINABILITY

Fashion’s Push to Switch Coal for Biomass a ‘Greenwashing Tactic,’ Advocacy Groups Say

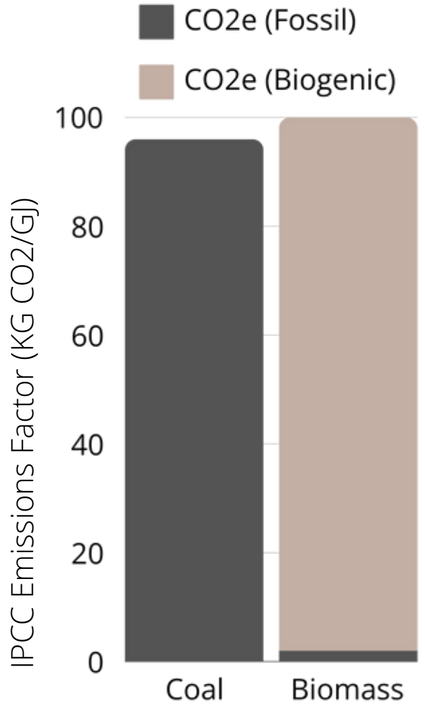
Support for the fuel from companies like H&M, Adidas and Inditex risks delaying a transition to cleaner energy sources and increasing deforestation, the organisations said.



How UNFCCC carbon accounting has created a biomass delusion and is contributing to climate change and global inequity.

By: Sophie Bastable | Nov 22, 2023

COAL VS BIOMASS GHG EMISSIONS



Source: GEI analysis of IPCC 2006 and Clean Air Task Force 2024

Changes to GHG accounting standards could nullify corporate climate efforts that use biomass.

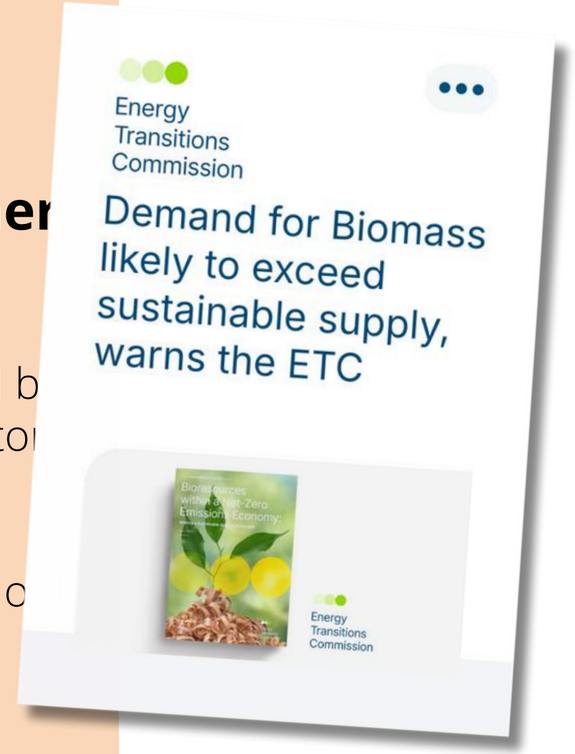
BIOMASS RISKS: INCREASING BIOMASS DEMAND FROM OTHER SECTORS, WILL INCREASE PRICES, POSING A RISK TO FACTORIES

2

Rising demand from other sectors

Limited biomass will be increased b
used by the hardest-to-abate secto
(cement, steel, transport).

In Vietnam, rice husk pellets could c
absorb 5% of current coal use
(28 of 569 TWh/year).[1] [2]



3

Price Risk

As demand for biomass increases, so will the price. This poses a business risk to factories. If biomass prices rise, thermal boilers risk becoming stranded assets.

Indeed, rising rice husk prices in Vietnam mean factories are switching to wood. However, wood poses greater traceability risks.

BIOMASS RISKS: BIOMASS ALSO HAS AIR POLLUTION AND TRACEABILITY RISKS

4

Air Pollution

Switching from coal to biomass does not solve issues of air pollution and its health effects. PM, CO, NOx, and SO2 levels are comparable between biomass and coal. Indeed, in China, regulations on air pollution have shifted factories away from biomass.

5

Traceability

Demand for biomass can drive deforestation if not sourced from certified, well-managed forests, impacting biodiversity and carbon sequestration.

ELECTRIFICATION OPTIONS: ELECTRIC BOILERS
EASY TO INTEGRATE, BUT INEFFICIENT COMPARED TO HEAT PUMPS

1

Source: Yuanda boiler

Tech overview:
Large, industrial-grade water heater that uses electricity to generate hot water or steam

Simple terms:
A very big kettle

Advantages:
Higher achievable temperatures of saturated steam (~180°C) compared to heat pump, easier to integrate into existing systems, lower investment costs, existing operation experience in relevant applications. Responds well to variable demand.

Disadvantages:
High cost of grid electricity = higher operational costs

Potential competitive cases today (2024)
Electricity price very low or very small hot water demand. Source curtailed renewable electricy

Current applications:
Larger installations in tobacco and pharmacy sectors where safety and local emissions more important than cost.
Small cut and sew facilities in textile factories

Efficiency & Performance

Greenhouse Gas Emissions

Integration & Complexity

CAPEX

OPEX

Key: Great, Good, Fair, Challenging

ELECTRIFICATION OPTIONS: INDUSTRIAL HEAT PUMPS
HIGH INVESTMENT COST BUT MORE COMPETITIVE WITH EXISTING THERMAL SOURCE

2

Source: GEA heat pump

Tech overview:
A working fluid (refrigerant) absorbs heat via an evaporator, compresses it to increase the temperature, and releases the heat at a higher temperature.

Layman's terms:
A reverse air conditioner

Advantages:
Highly efficient (250%+). Can provide both heat and cold demand. Can use a waste heat resource as input.

Disadvantages:
Higher upfront costs, not as modular, slow response to changes in demand. Must be coupled with compressor unit to produce temperatures above 120° (i.e., pressurised steam).

Potential competitive cases today (2024):
Economics better when hot water heat source and low heat demand/temperature (e.g. washing). And limited number of heat demand processes

Current applications:
Food and beverage sector where there are significant heating and cooling resources and medium constant temperatures
First project of H&M Group in China for steam generation

Efficiency & Performance

Greenhouse Gas Emissions

Integration & Complexity

CAPEX

OPEX

Key: Great, Good, Fair, Challenging

ELECTRIFICATION OPTIONS: DECENTRALISED SYSTEMS HIGHLY MODULAR FOR VARIABLE DEMAND

3

Source: Enerteam

Tech overview:
Small-scale, movable machines to produce on-demand steam for pressing, ironing, finishing

Layman's terms: Using electric irons, washing machines, water heaters, similar to how we use them at home

Advantages:
Variable, modular demand required by factory without complicated central system. Good when limited number of processes

Disadvantages: Impacts on production by changing workfloor organisation. Relatively high capital costs and not as efficient as a heat pump

Potential cases where competitive
Factories with one process (e.g. ironing)

Current applications:
Common decentralised ironing

Efficiency & Performance

Greenhouse Gas Emissions

Integration & Complexity

CAPEX

OPEX

Key: Great, Good, Fair, Challenging

ELECTRIFICATION OPTIONS: SOLAR THERMAL.
REQUIRES NO FUEL OR ELECTRICITY INPUT, REQUIRES SPACE

4

Tech overview:
Solar collectors absorb sunlight, which heats a fluid circulating through the system. This heat is then transferred to water in a storage tank.

Layman's terms: The sun heats up the water

Advantages:
Cost competitive for small amounts of heat; long lifespan (20+ years); not reliant on electricity grid.

Disadvantages:
Intermittent generation; requires backup or storage. Requires large amount of land. Technologies for higher heat (e.g. concentrated) immature in Asia.

Potential competitive cases:
Very large rooftop space
Pre-heating of water ahead of heat pump
Low temperature requirement

Current applications:
Leather industry (as high low heat demands) and typically more space
Pre-heating ahead of heat pump

Efficiency & Performance

Greenhouse Gas Emissions

Integration & Complexity

CAPEX

OPEX

Key: Great, Good, Fair, Challenging

ELECTRIFICATION OPTIONS: THERMAL STORAGE
GOOD BUSINESS CASE WHEN VARIABLE ELECTRICITY COSTS, BUT HIGH UPFRONT INVESTMENT

5

Tech overview:
Stores excess heat energy for later use in a medium (bricks, molten salt, concrete)

Layman's terms:
A giant battery (made of brick or salt) of stored heat

Advantages:
Stores heat for use later, good for levelling out fluctuating energy supply

Disadvantages:
High upfront costs, requires material and storage space

Potential competitive cases:
Favourable off-grid tariffs or cheap (oversized) solar

Current applications
First projects in China in areas with low night time tariffs
Currently limited to power generation and trials within heavy-industry (cement, metals).

Efficiency & Performance

Greenhouse Gas Emissions

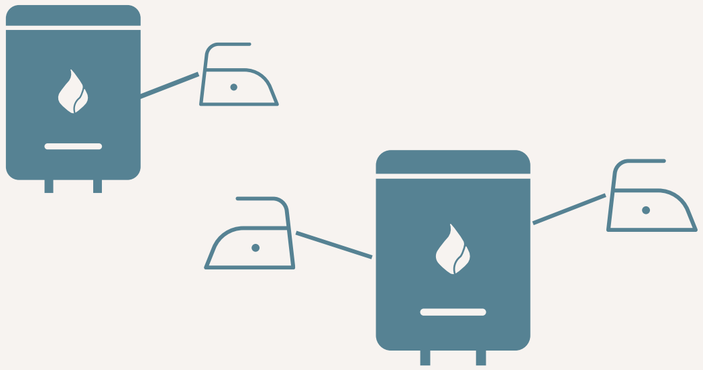
Integration & Complexity

CAPEX

OPEX

Key: Great, Good, Fair, Challenging

PROPOSED ELECTRIFICATION CASE 1:
DECENTRALISED ELECTRIFICATION FOR IRONING



What to look for:

- Factories with small or fluctuating steam needs
- Sufficient space within ironing quarters.

Proposed solution ① Factory 1 and 2

Currently, the facility's steam process runs at 30% efficiency (large standby loss due to overcapacity boiler). One biomass boiler could be replaced with 64 local electric boilers, each with capacity to power 2 irons. As the boilers are easily moveable and can be turned on/off independently, distribution and standby energy losses are greatly minimised.

Current ironing setup

Challenge

- Rising price of electricity
- Becomes more expensive than a centralised system if demand for steam increases substantially

PROPOSED ELECTRIFICATION CASE 2:
HOT WATER HEAT PUMP FOR LAUNDRY

What to look for:

- Factories where process heat demand is hot water at 70 - 90°C (lots of washing / dying; less ironing / pressing)

Proposed solution: Factory 3

Hot water for the wash process is currently provided by sparging with saturated steam at 6 - 9bar. This could be replaced with a heat pump.

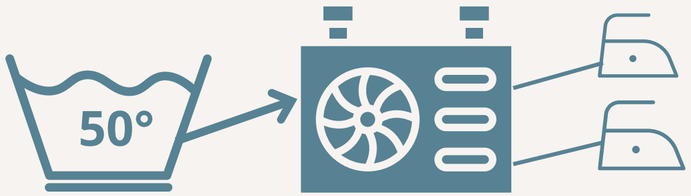
However, the wash process is not continuous. This coupled with more reactionary production planning means that process warm up times are short. Factories have become used to having steam at 130 - 150°C on hand to enable a quick start up.

We need to explore further with the factory team

Challenges:

- Requires greater planning and mode of operation (waiting for water to heat rather than instantaneous)

INITIAL PROPOSED CASE 3:
WASTE HOT WATER TO HEATPUMP FOR STEAM



What to look for:

- Consistent demand for steam
- Existing hot water source over 50°C

The opportunity

Increasingly heat pumps capable of producing steam are available on the market, and are already used in the food and beverage system (e.g. Heineken facility in Vietnam). These make particular sense when there is an existing hot water source in the facility.

Waste heat capture side of the heat pump can be used to reduce effluent temperature from the facility to reduce risk of upset in biological waste water treatment. offset workshop cooling demand.

Challenges

- Highest CAPEX; investment requires competitive interest rates and long-term business confidence.
- Business case weakens if hot water source is unavailable.

INITIAL PROPOSED CASE 4:
HEAT PUMP FOR BASELOAD, ELECTRIC FOR FLUCTUATING STEAM DEMAND

What to look for:

- Baseload + Fluctuating demand for steam
- Existing hot water source over 50°C

The opportunity:
Heat pumps are good at providing a steady, heat supply, but in the textile sector, particularly for dyeing, at given points of the day, a large quantity of heat is needed for a short amount of time. Oversizing the heat pump for these moments is not economically prudent. Therefore it may be possible to combine a heat pump with an electric boiler to improve the business case.

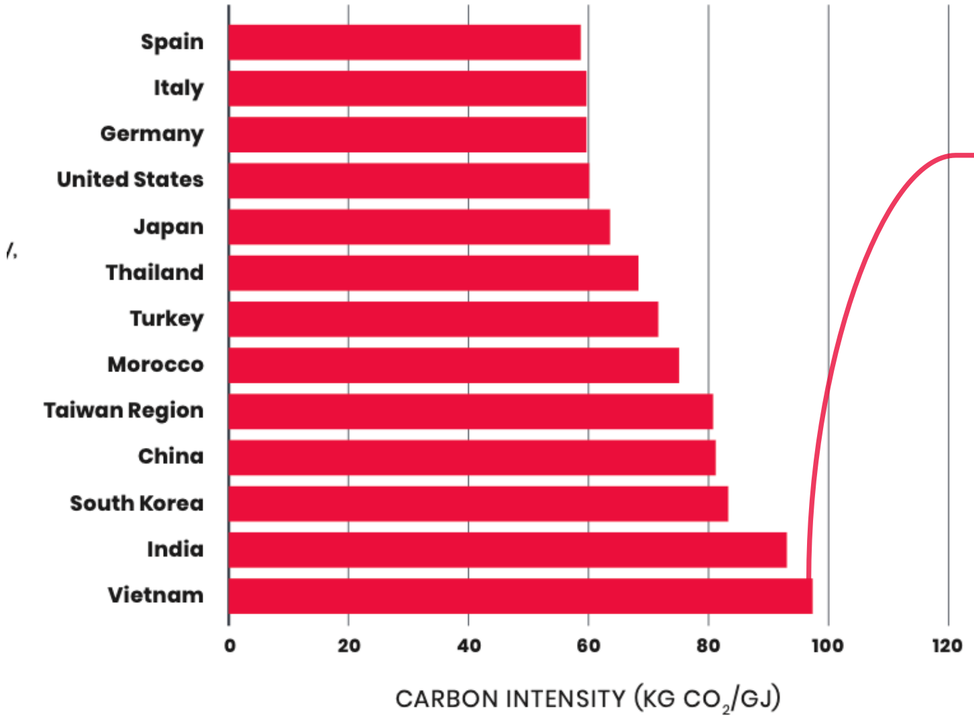
Further research will be needed on whether this is already carried out in other geographies

Challenges

- Requires getting two (competing) equipment providers for electric boilers and heat pumps to work together on an integrated hybrid solution.

ACCESS TO GREEN ELECTRICITY WILL BE IMPORTANT TO JUSTIFY THE CARBON IMPACT OF ELECTRIFICATION. SEVERAL OPTIONS ARE AVAILABLE

FUEL-WEIGHTED CARBON INTENSITY OF THE TEXTILE INDUSTRY IN TOP TEXTILE-PRODUCING COUNTRIES



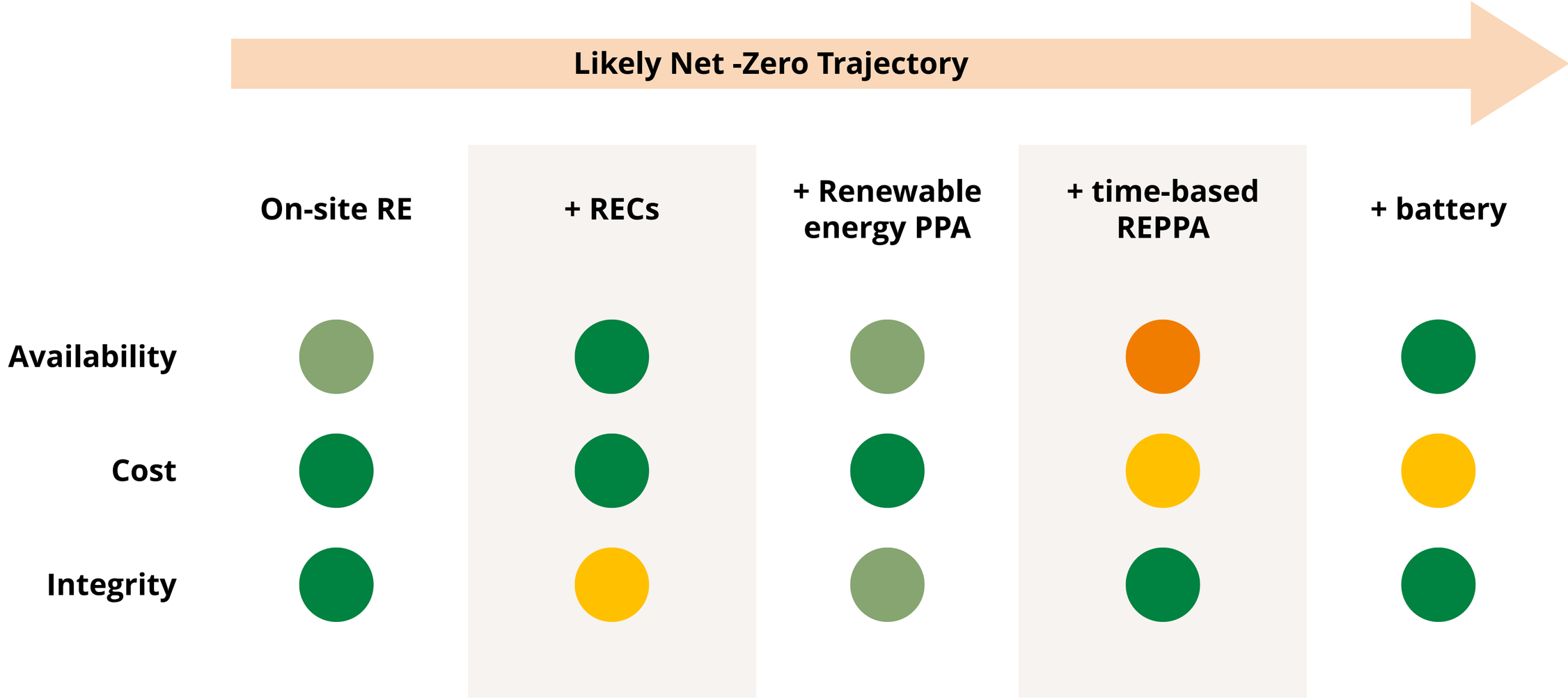
Source: Apparel Impact Institute

Vietnam's grid is coal dependent and has a high emissions factor.

Electrification may **increase** emissions in the short-term, under the GHG protocol, particularly if replacing biomass.

Therefore, factories using **green electricity** (solar, wind, REPPA) will be important.

ACCESS TO GREEN ELECTRICITY WILL BE IMPORTANT TO JUSTIFY THE CARBON IMPACT OF ELECTRIFICATION. SEVERAL OPTIONS ARE AVAILABLE

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