



DECARBONIZATION OF HEAT

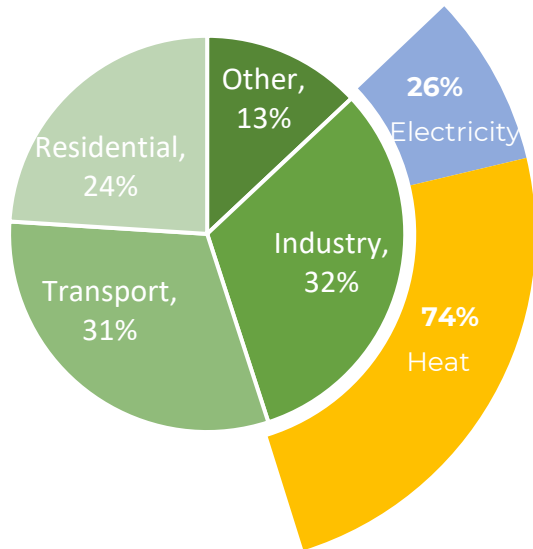
March 2022



Industrial Heat

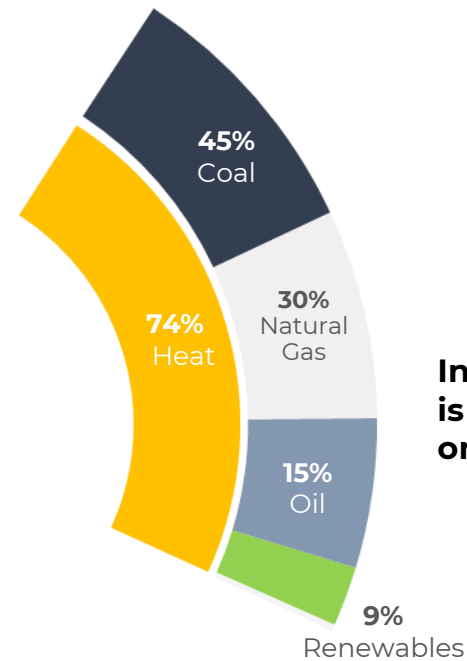
Renewable based heat is a crucial for net-zero emissions

Global Energy Consumption



Industrial Heat
accounts for
1/4
of global energy
consumption

Energy sources for Industrial heat



Industrial Heat
is heavily based
on fossil fuels

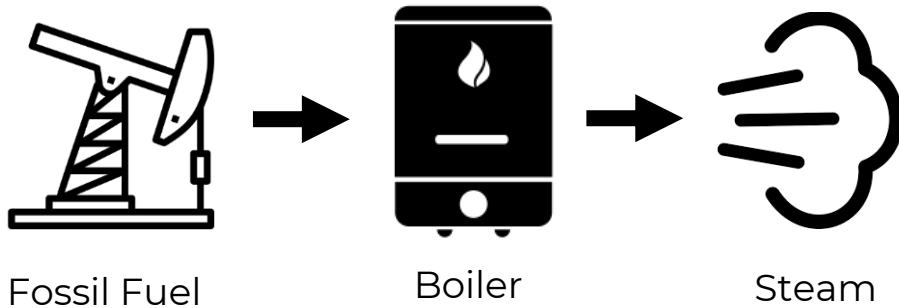


Decarbonizing Industrial heat

Thermal storage allows integrating renewables for heat generation

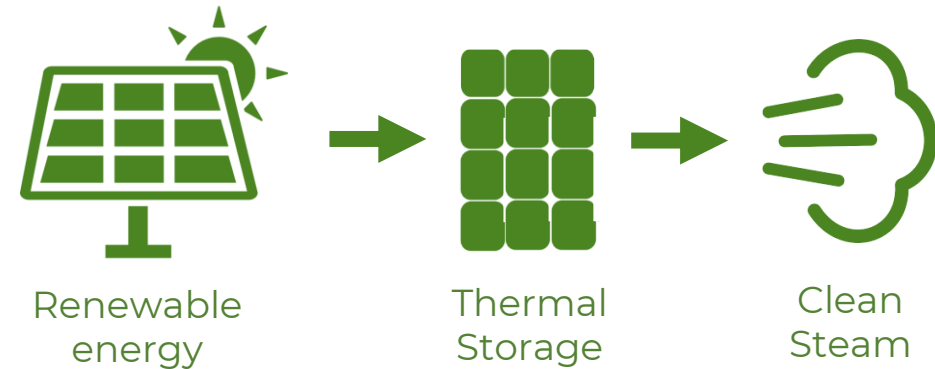
Traditional steam generation

fossil fuels are available, flexible and reliable



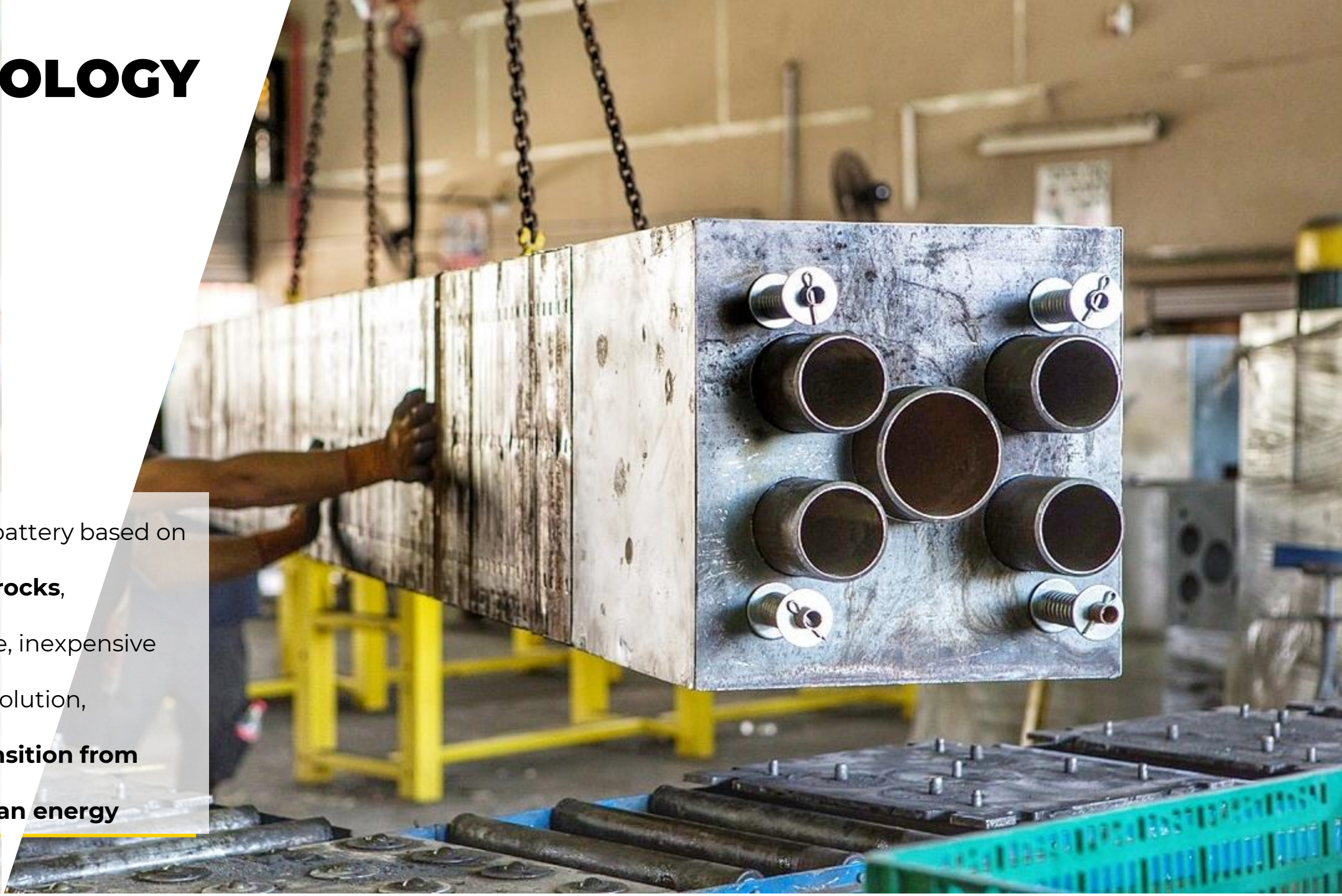
Clean steam generation

Renewables + storage allows flexible and stable operation



TECHNOLOGY

A patented heat battery based on **natural crushed rocks**, creating a durable, inexpensive thermal storage solution, **enabling the transition from fossil fuels to clean energy**



bGen 750° Thermal Energy Storage



Charging the bGen with electrical heaters



Clean



1MWh-100MWh

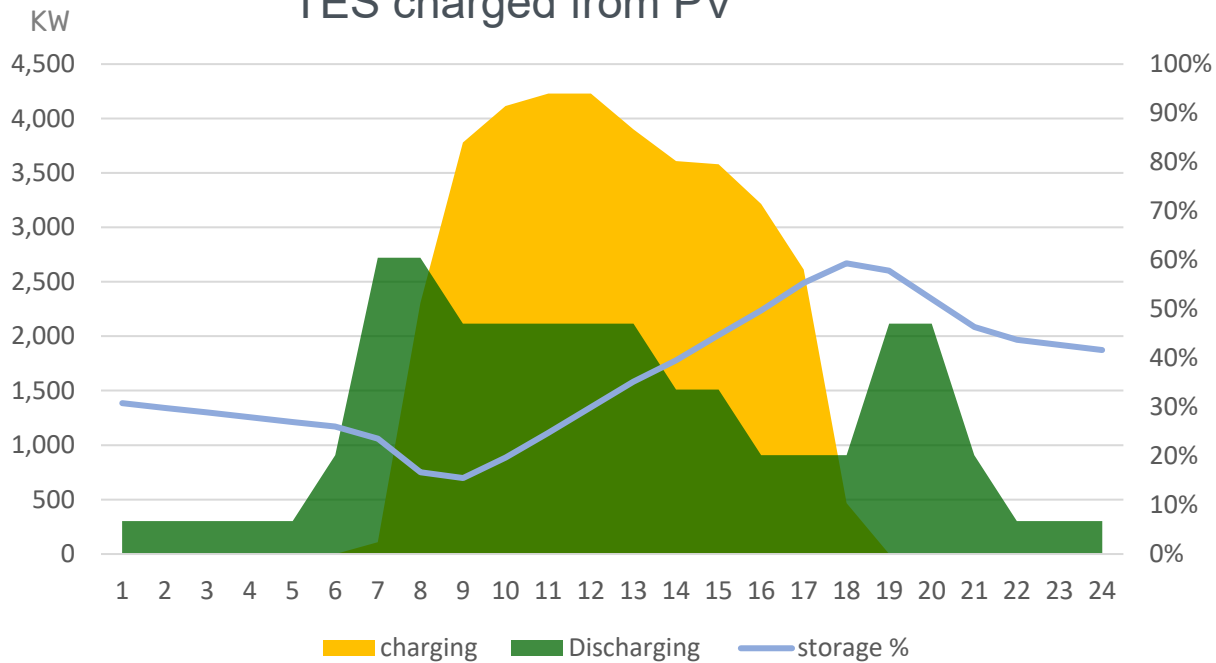


30+ Years



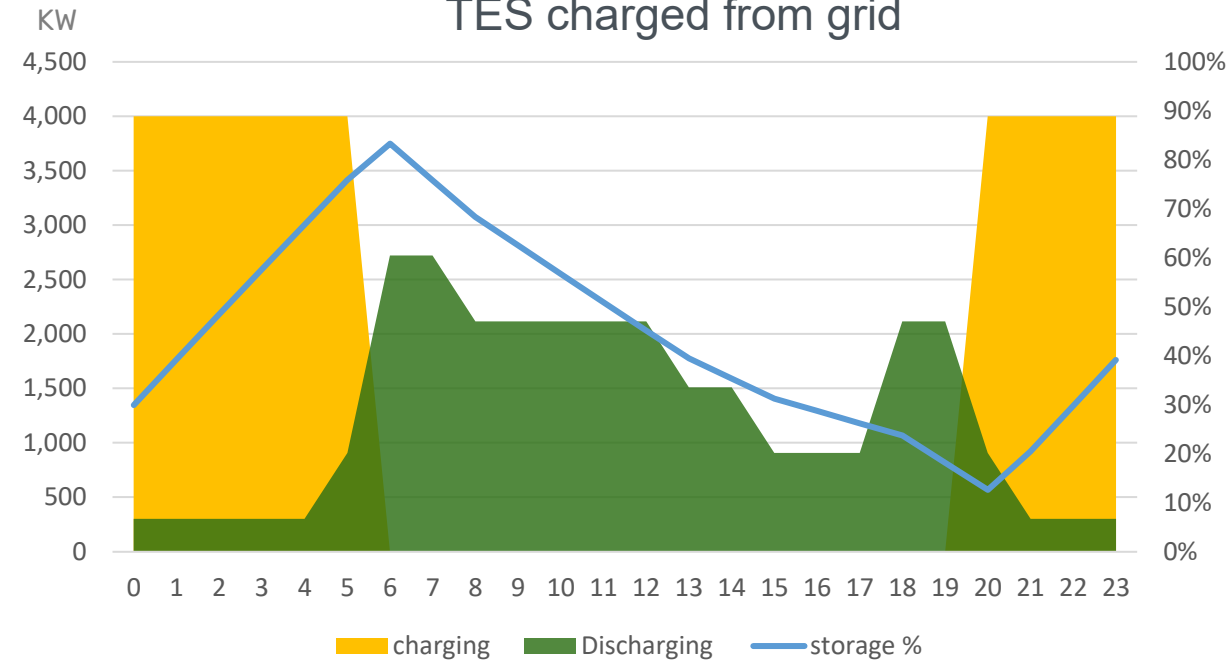
How it works

TES charged from PV



- ▶ Charging with during solar hours
- ▶ Delivering steam on demand

TES charged from grid

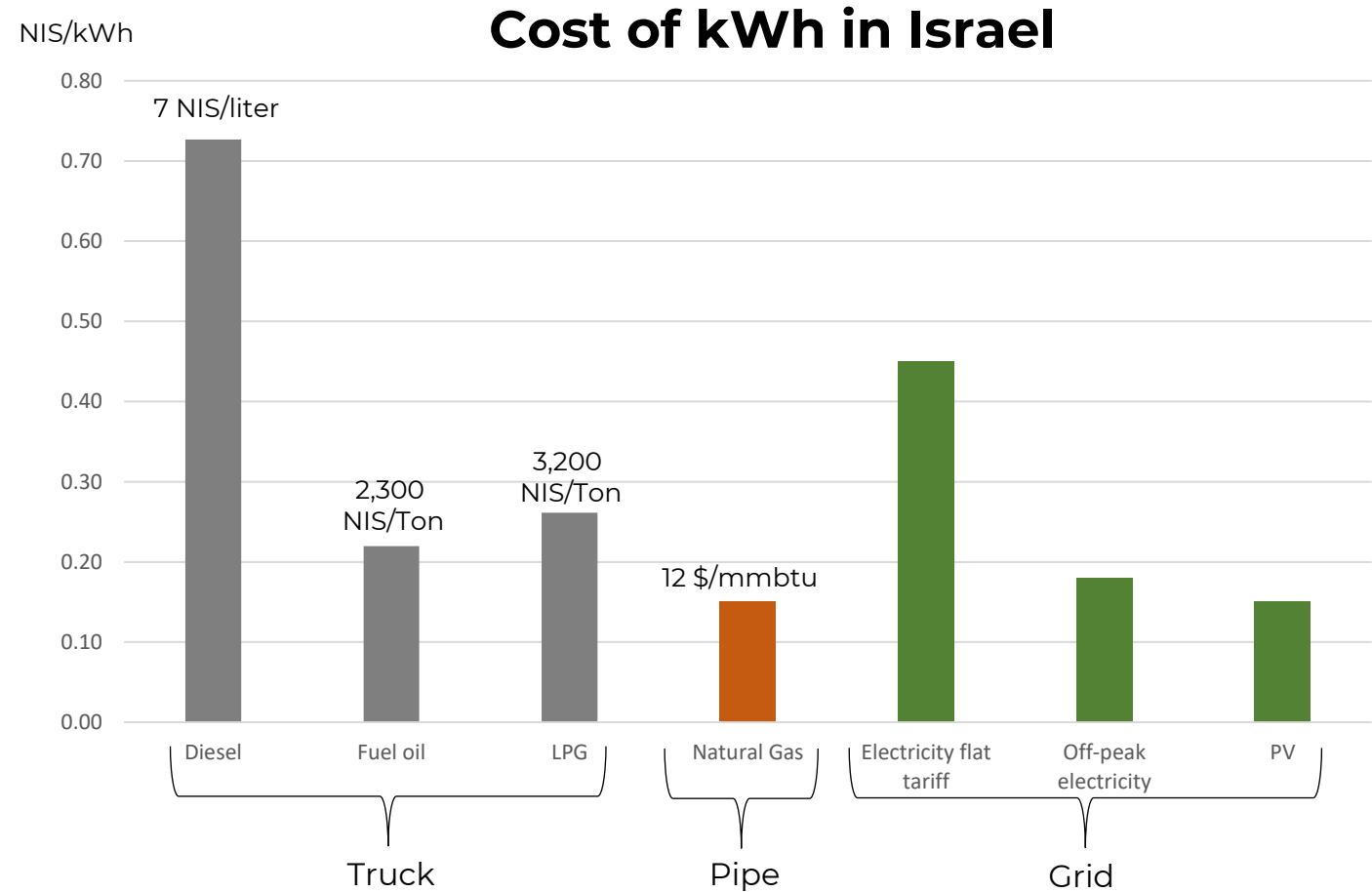


- ▶ Charging during Off-peak electricity
- ▶ Delivering steam on demand

Green is more green \$

Regulation continues to improve ROI

- ▶ Increasing carbon tax will escalate fuel-based cost of energy
- ▶ Off-peak electricity price will continue to decline
- ▶ Reducing risk of volatility



Containerized Thermal Storage



1MWh Thermal Storage based co-generation

- Hybrid charging – flue gas and electricity
- Discharging hot water

commissioning



4MWh Biomass based storage system

- Charging from combustion of wood chips
- Discharges hot air

commissioning



Bulk Thermal Storage



24MWh thermal storage in gas power plant

- Superheated steam for power generation
- Allowing energy shifting and flexible operation of PP



PHILIP MORRIS
INTERNATIONAL

32MWh Biomass based thermal energy storage

- Saturated steam for processing
- Allowing flexible operation with continuous biomass combustion



Thank you

