# Kaaj Energy

## Energy Storage Solutions

### For a Carbon-Neutral Future

# KAAJ ENERGY INC.

KAAJ ENERGY
ZERO CARBON

Kaaj provides customized electricity storage and waste heat recovery solutions for green, effective and efficient power generation.

Our solutions lower energy cost, reduce carbon intensity of power generation and maximize utilization of renewable power for industrial, municipal and utility clients.

Our proprietary, environmentally friendly solutions are provided from A-Z in a one stop shop, from conceptual design to installed equipment, fully commissioned with verified cost savings, swift payback and carbon credits.

# WHY WASTE HEAT RECOVERY?

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- **50%** of energy consumption is released into water or atmosphere in form of wasted heat

| Temp Range | Example Sources | Temp (°F) | Temp (°C) |
|---|---|---|---|
| **Medium** 450-1,200°F [230-650°C] | Steam boiler exhaust | 450-900 | 230-480 |
| | Gas turbine exhaust | 700-1,000 | 370-540 |
| | Reciprocating engine exhaust | 600-1,100 | 320-590 |
| | Heat treating furnace | 800-1,200 | 430-650 |
| | Drying & baking ovens | 450-1,100 | 230-590 |
| | Cement kiln | 840-1,150 | 450-620 |

- Waste incinerators in Canada

| Plant | Incineration capacity | Generation capacity |
|---|---|---|
| PEI | 4 t/h | 2 MW |
| Sarnia, ON | 10 t/h | 5 MW |
| Quebec, QC | 38 t/h | 19 MW |
| **Total** | **52 t/h** | **26 MW** |

**Our solutions harness this waste heat to produce carbon free electricity.**

# WHY ELECTRICITY STORAGE?

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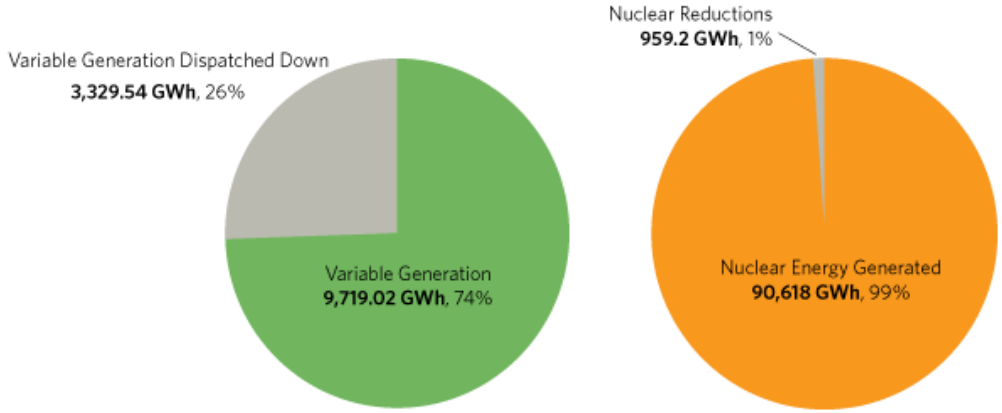
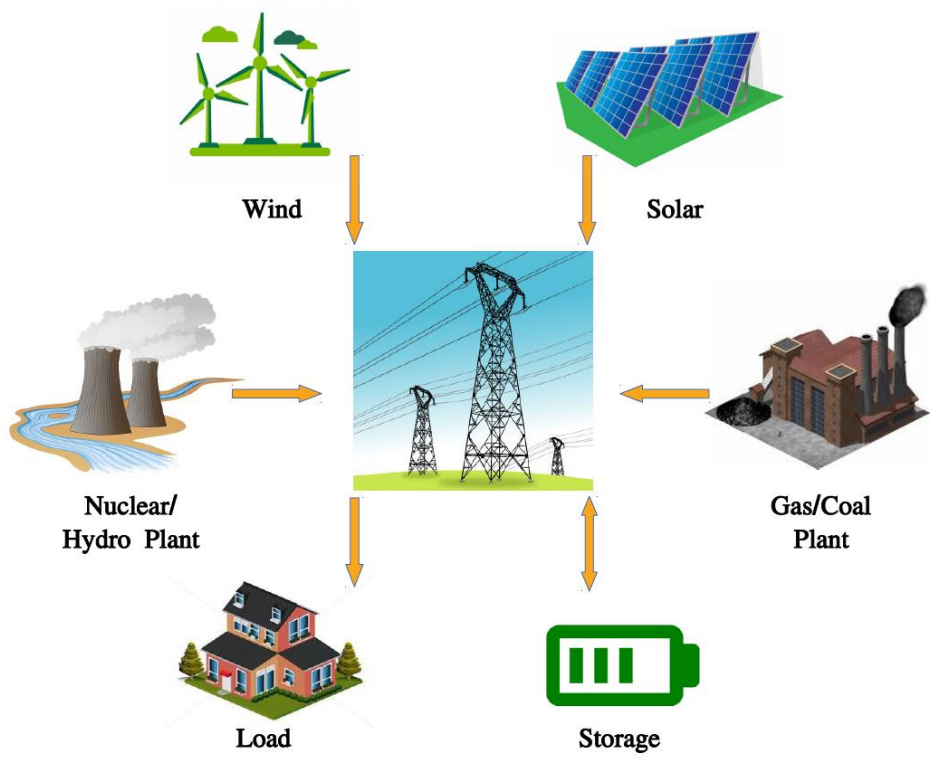
- Balance the supply & demand
- Maximize utilization of renewables
- Reduce carbon emissions
- Reduce energy cost




Ontario, 2017



# THERMAL ENERGY STORAGE

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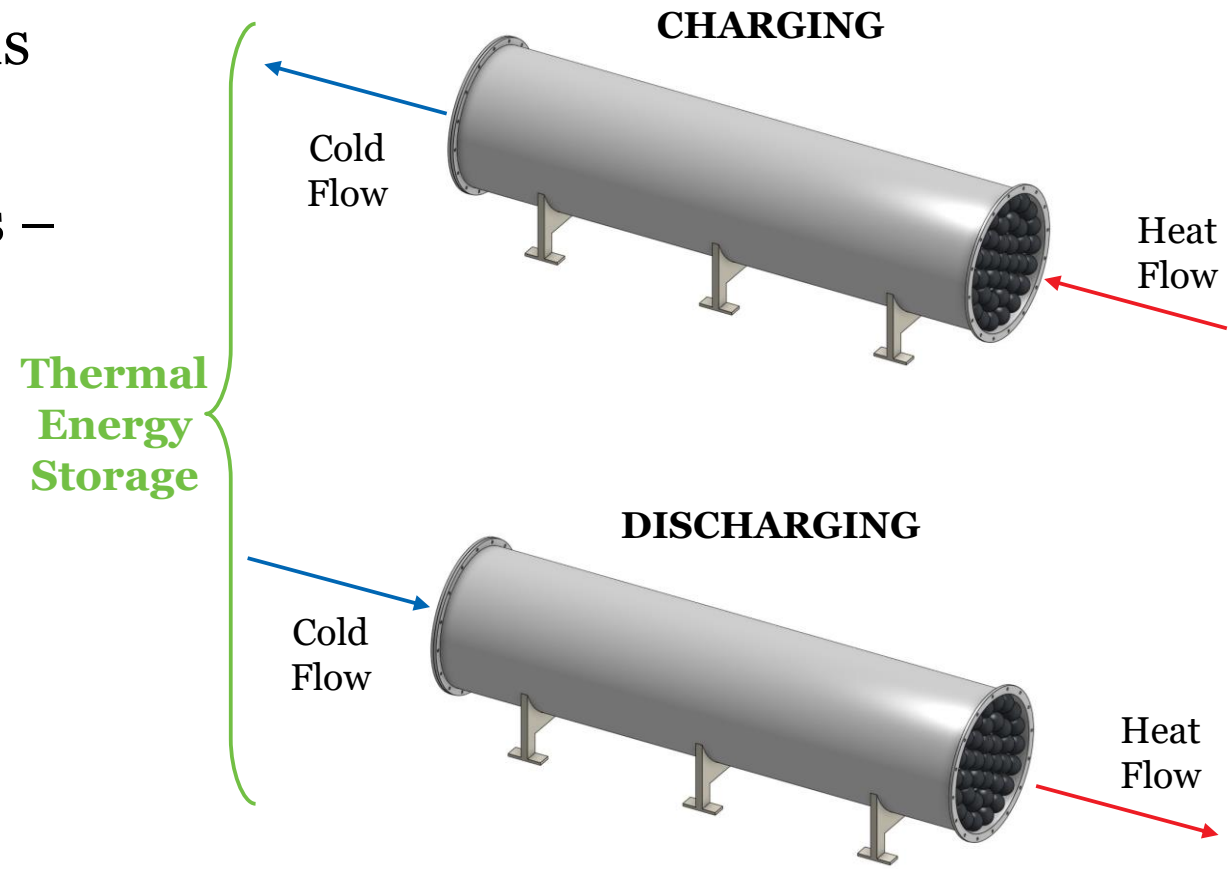
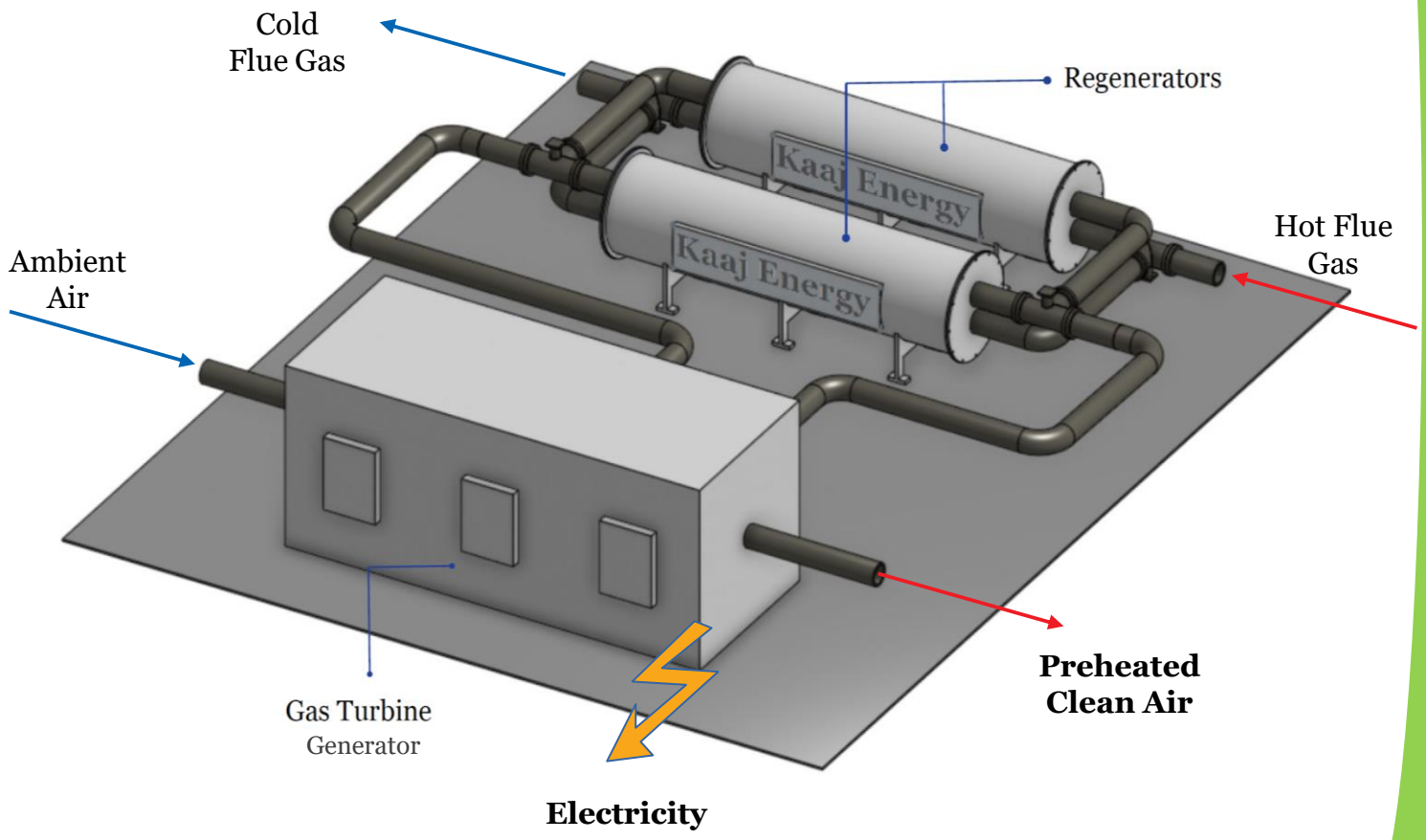
- TES Concept: granular minerals inside a tube
  - Granular minerals (rocks, ores – temperature dependent)
    - Heat storage medium
    - Heat transfer surface
  - Tube
    - Contains the minerals
    - Conduct the flow



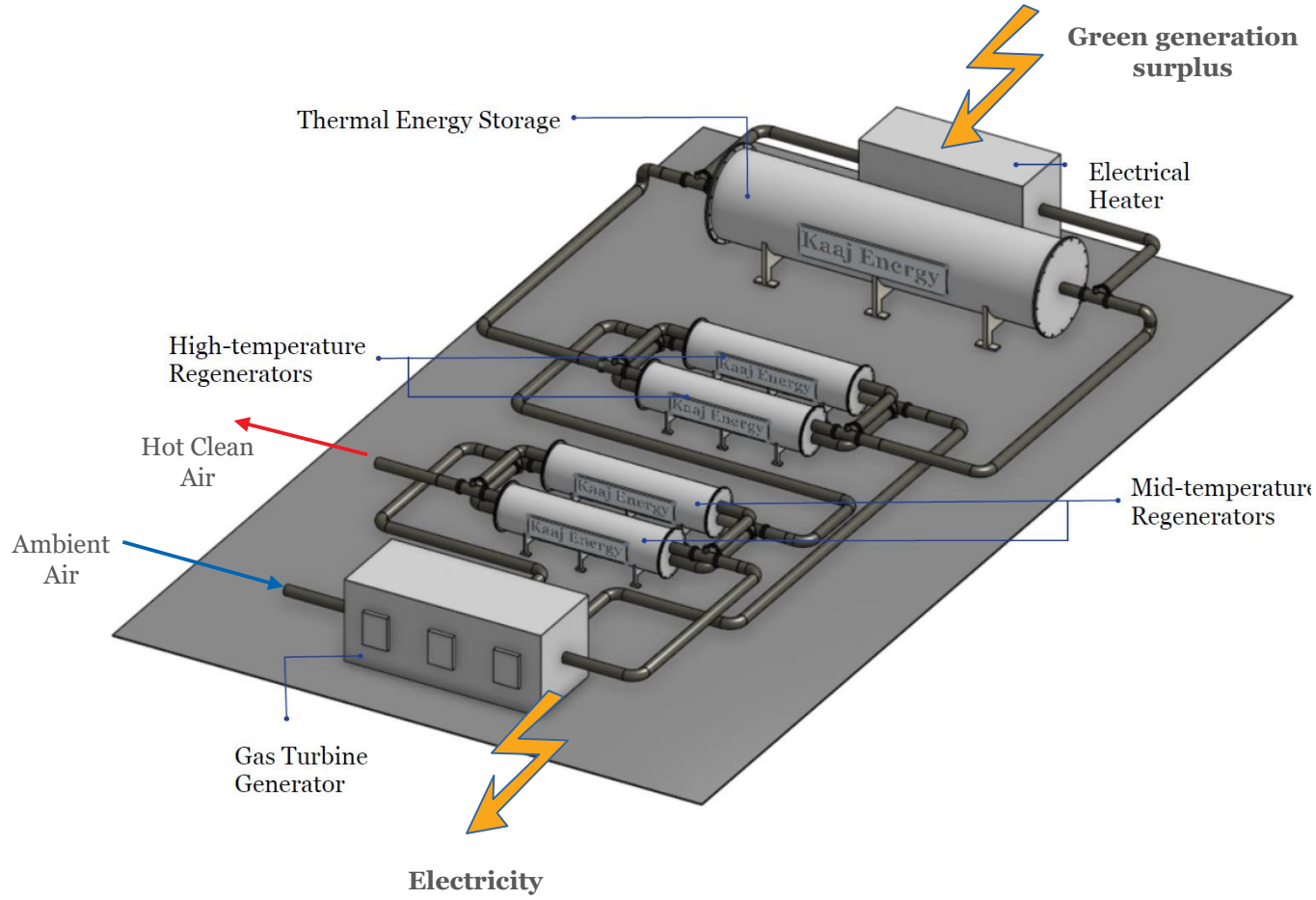
# KAAJ-WHR-CHP SOLUTION

- Harness industrial waste heat with regenerators.
- Use the captured heat to run a gas turbine.
  - No fuels burnt for power generation
- Convert waste heat to electricity and useful heat.
- 15-40% reduction in energy consumption and carbon emissions



# KAAJ-ES-CHP SOLUTION

- Charging:
  - Electrical Heater: Converts electricity to heat (800°C).
  - Thermal energy storage ("TES"): Stores the high-quality heat.
    - Possible to store industrial waste heat as well
    - Modular design, easily scalable for long storage duration (>4 hours)
- Discharging:
  - Turbine unit: Converts the stored heat to electricity and useful heat.
    - No fossil fuel is used for power generation
  - Regenerators: Improve system efficiency by recovering heat from turbine exhaust.



# SOLUTION BENEFITS

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- Lower capital cost over other energy storage systems
- Net savings in recurring energy costs up to 40% and significant carbon credits resulting in swift payback
- Rapid response time of one minute
- No efficiency or storage capacity degradation
- Smaller footprint requiring much less space
- Much longer plant life, 20+ years life cycle
- No boilers, condensers or water treatment required
- In addition to electricity, produces hot clean air that can be used for heating facilities

# CASE STUDIES

1. CHP for an agriculture company in Alberta
   - 9-MW gas turbine + 2-MW Kaaj-WHR-CHP
2. CHP for a municipal waste incinerator in Alberta
   - Power generation with no water consumption
3. CHP for a mineral processing company in the Netherlands
   - Convert kiln's waste heat to electricity and process heating
4. ES for a food company in the Netherlands
   - Store off-peak electricity, generate steam during peak hours
5. Decommissioned coal plants to utility-scale electricity storage
   - Use existing turbines, boilers, and grid connection

# FEASIBILITY STUDY AS A FIRST STEP

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- Feasibility study provides details of a design and front-end engineering study which includes:
    - Process flowsheet with material and energy balances
    - List of major items of equipment
    - Total installed capital cost estimation
    - Energy cost savings and carbon credits estimate
    - Carbon emission reduction estimate
    - System footprint
    - Financial metrics, payback, IRR and ROI estimate
    - Investment solution and Project financing.
- **The solution may allow for long-term power-as-a-service model (no upfront cost for the client).**

# TEAM

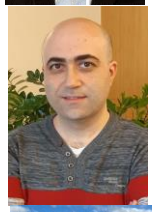
**Michael Avedesian**, PhD, P.Eng, FCAE, FCIC: Chairman of the Board. 35 years of operation, technology, and business management experience. Founding CEO of three start-ups, one leading to IPO. Board Member of TM4, recently sold to Dana Corp. Currently a Senior Associate, Advisor and Lecturer at McGill University.

**Reza Lotfalian**, PhD: Founder, President & CTO - 8 years of experience in energy storage, 3 years of experience in manufacturing, project lead on $20+M energy storage projects.

**Alain Guerard**, MBA: Director, Business Development - 35 years of experience in industrial project services in a variety of sectors including power transmission and consultant on international projects to firms such as KPMG, SNC Lavalin, and Skylink Aviation.

**Ali Shojaei**, PhD, P.Eng: Co-founder, Director, Power Systems – 5 years as Engineering Manager at Schneider Electric. Experience in product development and manufacturing, business development, power systems design, operation, and controls.

**Melanie Tetreault-Friend**, PhD: Advisor/Consultant, Assistant Professor at McGill University – Specialized in thermal-hydraulics in advanced nuclear and solar-thermal plants. Worked in the UAE on development and construction of an advanced molten salt system for CSPonD project.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# Thank you!


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President and CTO

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