Biomass in district energy

Bioenergy Association

COFELY GDF SUEZ

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BY PEOPLE FOR PEOPLE

GDF SUEZ: The Business Lines

- €87B (A$120B) in 2013 revenues.
- A presence in close to 70 countries.
- 146,200 employees throughout the world:
  - Inc. 60,050 in power and natural gas
  - and 86,000 in energy services.
- 800 researchers and experts in 7 R&D centres.

Power

- **No.1** Independent Power Producer (IPP) in the world.
- **No.1** producer of non-nuclear power in the world.
- **117 GW** of installed power-production capacity.*
- **7.2 GW** of power capacity under construction.*

Natural gas

- **No.2** purchaser of natural gas in Europe.
- **No.3** importer of LNG in the world.
- **No.1** natural-gas transmission and distribution networks in Europe.
- A supply portfolio of **1,208 TWh**.

Energy services

- **No.1** supplier of energy and environmental efficiency services in the world.
- **No.2** supplier of water and waste services in the world.
- **186** district heating and cooling networks operated worldwide.

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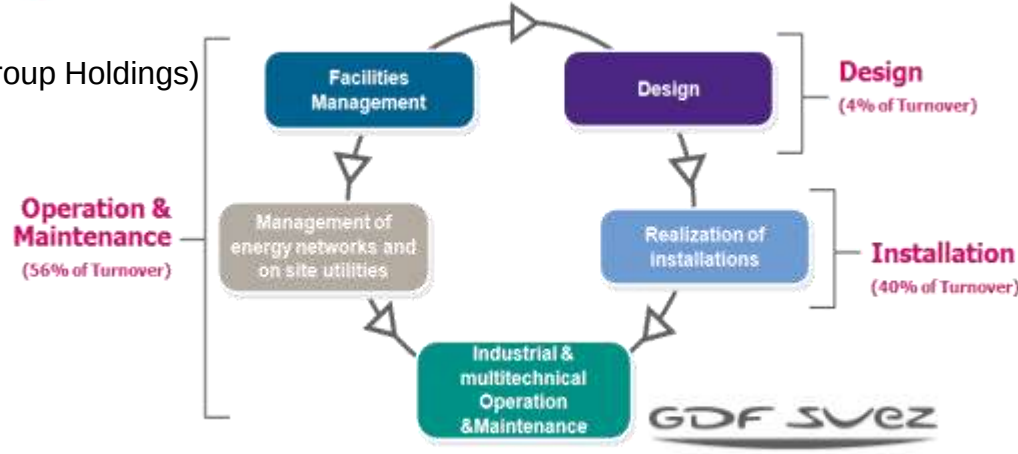
World Leader in Energy Services:
A solutions provider close to its customers

14.7€/A$21 billion
Revenues

86,000
employees around the world

A presence in nearly
40 countries

30
Locations across Australia & NZ (through TSC Group Holdings)



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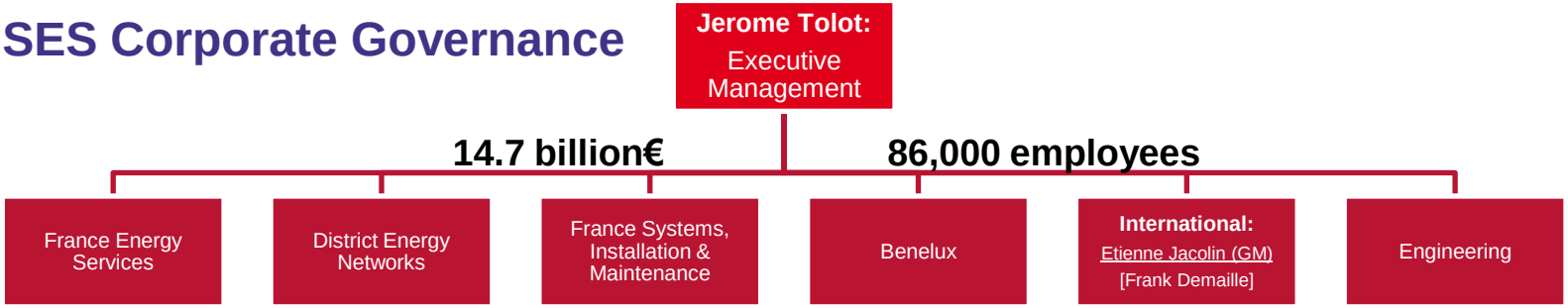
GSES Corporate Governance



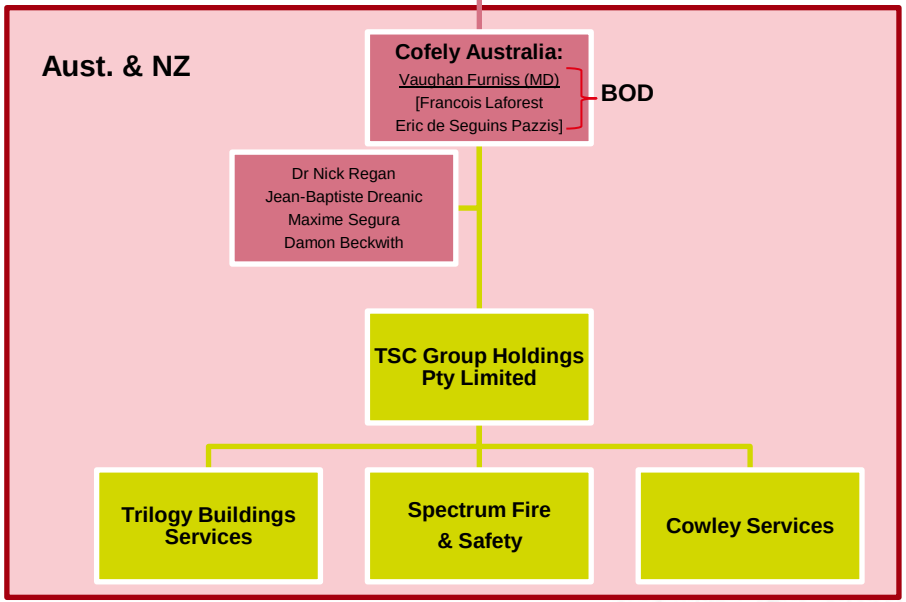
2013 Key Figures:

14.7 billion €
Revenue

1.068 billion €
EBITDA

705 million
Net Current Income

374 million
Recurring Net Income
Group share



Energy Services: Core Competencies

COFELY: the Brand of GDF SUEZ Energy Services

- We offer environmental and energy-efficient solutions to:
  - Industrial
  - Tertiary & commercial
  - Local authorities
  - Public administration and
  - Infrastructure
- customers through services which are:
  - Multi-technical (electrical, mechanical and HVAC engineering and system integration)
  - Multi-service (engineering, installation, maintenance, operation, facility management)
  - Multi-energy (renewable energy sources, gas, etc.)

Cowley Services

- A national provider of tailored HVAC & R (Heating, Ventilation, Air Conditioning & Refrigeration), energy & environmental solutions and essential services.
- **A team of experienced technicians, engineers and project managers** who are supported by a dedicated customer service and back office team.
- 10 offices located across New Zealand
- 150+ employees
- ISO 9001 accredited
- Operational provider and partner to Cofely

- Through its partnership with **Cowley Services, Cofely has the local capability** to implement a diverse array of **Guaranteed Energy Efficiency Performance contracts** for all segments of commercial and industrial clients. This includes options for **build own transfer and build own operate** energy efficiency solutions for existing Brownfield and Greenfield projects

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UCL

Birmingham City Council

HSBC

IOE Leading education and social research Institute of Education University of London

SOUTHAMPTON CITY COUNCIL

Leicester City Council

NEW HOLLAND AGRICULTURE

ABP Associated British Ports

HYATT HOTELS & RESORTS

BMW

CREDIT SUISSE

MAIRIE DE PARIS

AÉROPORTS DE PARIS

HM PRISON SERVICE Public Sector Prisons

MICHELIN

CARNIVAL UK

University of Leicester

HER MAJESTY'S COURTS SERVICE hmcs

DAIRY CREST

BRITISH AIRWAYS

HAMPSHIRE CONSTABULARY

Kellogg's

accenture

ROLLS ROYCE

BRITISH LIBRARY

University of London

Nestlé

nationalgrid

Westfield

ExxonMobil

LOUIS VUITTON

INTERCONTINENTAL HOTELS & RESORTS

CPS

Premier Inn

BAA

SOAS University of London

London STOCK EXCHANGE

IKEA

Aston University Birmingham

VISY FOR A BETTER WORLD

CHANEL

Birmingham Children's Hospital NHS Foundation Trust

NHS

Birkbeck UNIVERSITY OF LONDON

Green Building Council of Australia & Property Council of Australia: Winner Green Cities 2014

District Energy & Biomass

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Leighton Properties: Kings Square

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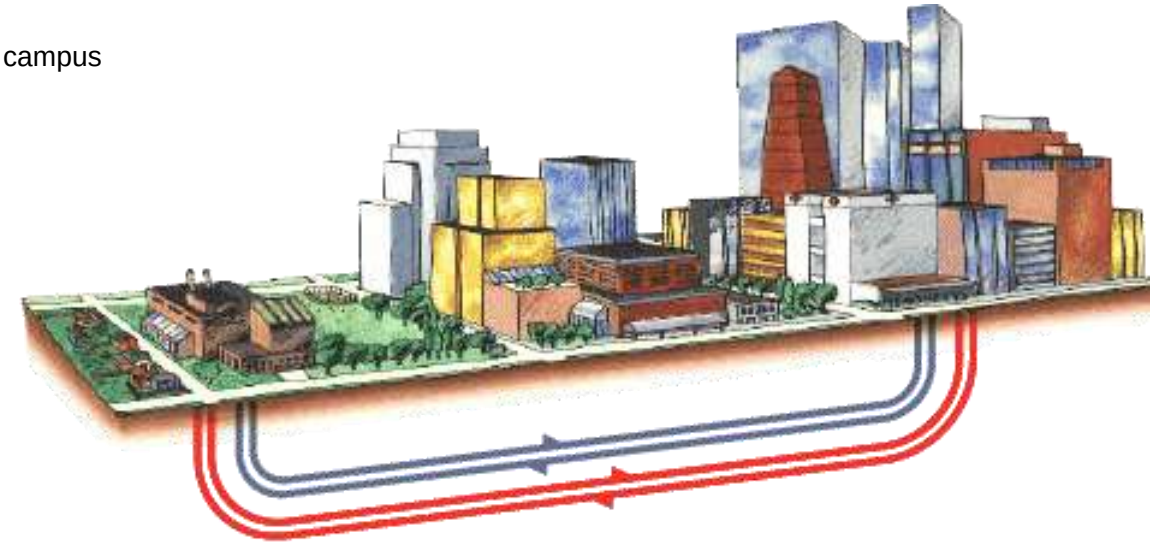
District Energy: What is it?

- The linking of thermal (heating and/or cooling) energy customers on a private energy network.
- Schemes can be:
  - Small, a precinct of a few buildings or campus
  - Large, city grids
- Thermal mediums:
  - Chilled water
  - Hot water (LTHW, MTHW)
  - Steam
- Networks are usually buried pipes:
  - Pre- or post- insulated steel pipe or
  - PEX (plastic)
  - <1˚C per km
- Fuel sources:
  - Conventional: gas, electricity, coal
  - Unconventional: biomass (solid, liquid & gas), geothermal, others



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District Energy: Key Benefits & Challenges

- Compared to conventional (BaU) approaches, District Energy can provide a number of benefits for customers:
  - Energy Cost Savings (CAPEX, OPEX and REPEX)
  - Carbon Abatement
  - Space Savings in Buildings (chillers, heat rejection, boilers all removed from site)
  - Hygiene Benefits (noise, health, vibration, etc.)
  - Risk Transfer (outsourcing non-core business activity)
  - Reduced Water Consumption
  - Improved resilience
  - Future proofing

- Challenges:
  - Energy density of customers (kW and kWh)
  - Geographic proximity of customers to one another
  - Catalyst
  - Long term view
  - Cultural barriers
  - Economics (CAPEX, plant utilisation & optimisation, etc)

Biomass in District Energy

- Why use biomass?

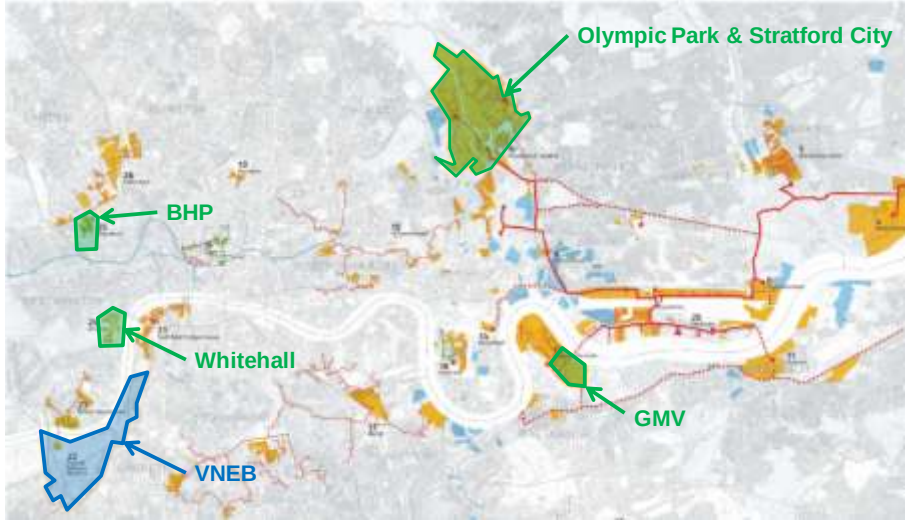
A. Achieve CO_2 savings compared to fossil fuels:
   - Low and zero carbon fuels

B. Planning Requirements:
   - "Merton Rule", London
   - Building Regs, Part L

C. Allow fuel switching:
   - Depending on primary energy tariff, then proportion of energy supplied from particular fuel sources can be varied

D. Lack of conventional fuels:
   - Availability of Natural Gas
   - Proximity to conventional utilities (electricity)

E. Economic benefits:
   - Renewable Heat Incentive: RHI (UK)
   - Enjoy reduced GST/VAT rates (France: if >50% of fuel mix is biomass, then lower VAT)
   - Renewable Obligation Certificates: ROC (UK)
   - Reduced EU-ETS exposure

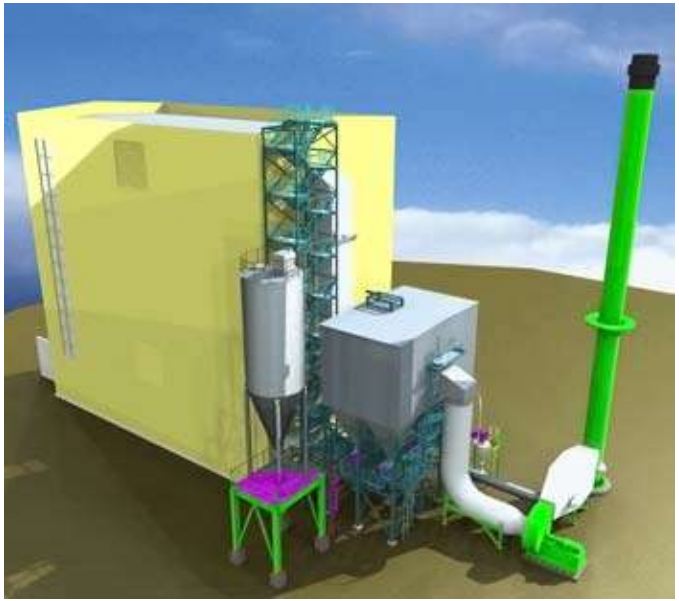


London Heat Map

Challenges of Biomass in District Energy

- Investment in biomass solutions are made through:
  - balance investment risk against operational risk

  Against
  - Economic benefits (IRR and ROCE)
- Operational:
  - Energy density: (MJ/kg)
  - Reception & Storage facilities: (MJ/m^3)
  - Size (if chip)
  - Handling systems
  - Plant efficiencies
  - Maintenance requirements and attendance
  - Air quality (especially in dense urban environments)
  - Transportation of fuel to site
- Economic:
  - Tariff
  - Tenure of contract, long term fuel supply security
  - Quality (moisture content)
  - Quantity and Availability (on a long term basis)
  - Indexation: coupled to equivalent conventional fuel
  - Investment CAPEX, OPEX and REPEX



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Overcoming Challenges

- Working Collaboratively with Suppliers
  - — Some schemes are community based projects:
    - Local supply of biomass
    - Centralised collection points
    - Delivery and sorting of fuel stock
  - — Long term contracts (5 – 10 years)
    - Educating of suppliers
    - Agreeing an indexation which is not decoupled for conventional fuels
    - Output specification contracting to control fuel quality:
    - Moisture content (tolerances)
    - Chip size (mass)
    - Variability of supply
  - — Direct management of supply chain
    - Ownership of plantations and crops
    - Processing plants and mills
    - Specialist business managing procurement
- Developed Mass Supply
  - — Significant volumes ex-North America (Canada)
    - Co-firing thermal power plants (e.g. Drakes)

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COFELY's investment in Biomass (in France)

- Cofely is operating at present more than 150 biomass energy centres in France.
- By enhancing as best as possible the value of the fuels available locally, COFELY uses in such energy centres use a wide diversity of biomass fuels:
  - wood chips
  - ground pallets
  - Sawdust
  - flax shives
  - Barks
  - wood granules and
  - waste from first and second wood processing industries).
- Such energy centres are servicing in particular:
  - Businesses
  - blocks of council flats
  - Hospitals
  - homes for the elderly and
  - secondary schools,

where biomass fuel is delivered on site. There are some industrial sites, where biomass by-products are exploited on the spot, in order to meet the heat and steam requirements.

Eco-district GINKO (Bordeaux – France)

- Key figures:
  - 2,200 homes / 32 hectares
  - 2 schools, 28 000 sq meters of shops, 25,000 sq meters of offices and services
  - Design, finance, build, operate and maintain as part of the urban project “**2030 Bordeaux: to the great Bordeaux, a sustainable city**” the schemes which supply heating
- Cofely solutions:
  - Creation of a district heating network feeding the whole neighbourhood
  - Biomass boiler
  - Saving of 3,500 tons of CO_2 per year thanks to renewable energy sources
  - Commit to producing all heat from renewable energies
  - Guaranteed savings on the energy bill

Industry Grand Couronne (France)

- Key elements:
  - Start operation date: January 2012
  - Duration of the Contract: 5 years
  - Client: Saipol Industry
- Cofely solutions:
  - Boiler capacity: 55 MW & 66 t/h of steam – 510°C & 92 bar
  - Biomass consumption: 160,000 t/yr, i.e. 25 to 30 trucks / day
  - Capacities of TAG / ACC / SG: 9 MWe / 6 MW / 30 MW
  - Global efficiency: 75%
  - Number of suppliers: 18 (with 11 in the site)
  - Duration of project: 40 months
  - Duration of commercial contracts 20 years

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Cofely East London Energy: Queen Elizabeth Park

- Site characteristics:
  - Sporting venues – Velodrome, Stadium and Aquatics
  - Athletes Village (240 000 m²) – being converted into 3,000 apartments in Legacy
  - Westfield Development (180 acre area)
  - Westfield Shopping Centre – largest shopping centre in Europe
  - 7,000 additional homes being constructed in Legacy
  - Media and Press Centre being converted into a data centre

- Cofely solutions:
  - Construction and operation of energy centres
  - The Energy Centre Heating plant:
    - Gas reciprocating CHP engines
    - Biomass boiler (3.5MW) / Dual Fuel (Gas & Oil) boilers (80MW)
    - Large thermal storage tanks (750m^3)
  - Reduction in CO_2 emissions / Reduction in energy costs
  - The Energy Centre Cooling plant:
    - Absorption chillers (8MWr)
    - HV Electric chillers (ammonia) (49MWr)
    - Open Cooling Towers
    - Large thermal storage tanks
  - Total Capacities : 92.5 MW Heating / 57 MW Cooling / 9 MW Electrical

Cofely East London Energy: Queen Elizabeth Park

- Video

Industry: Michelin (Cholet – France)

- Site characteristics:
  - Diversity of production resources: biomass boiler plant, 10 MW, 22,000 tons of wood per year
  - Combined heat and power of 10 MW with a waste heat boiler of 24 MW equipped with a post/combustion/fresh air burner
  - Natural gas boiler 24 MW
- Cofely solutions:
  - Construction and operation of energy centres
  - Supply of fluids and power distribution, via operation and maintenance of existing installations and addition of new installations to optimize this supply
  - 12,000 tons CO_2 emissions avoided per year

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Bio-oil: Tagabé – Efate, Vanuatu

- 2x 4 MW MAN - Diesel / Heavy Fuel Oil
- Mix with a maximum rate of 30% of copra oil
- Cofely has developed its own fuel supply chain (Copra)
- Injection regulated with the load
- No injection under 80% of load (3MW) because risk of :
  - Injectors dirtying and unburned deposit
  - Lubricant pollution
- Weekly analysis of the engine lubricant is required: TAN, TBN & viscosity because of the risk of lubricant oxidation and of injection system corrosion.
- The mix can reach 30% of copra oil but above this value consequences on operation & maintenance are unknown.

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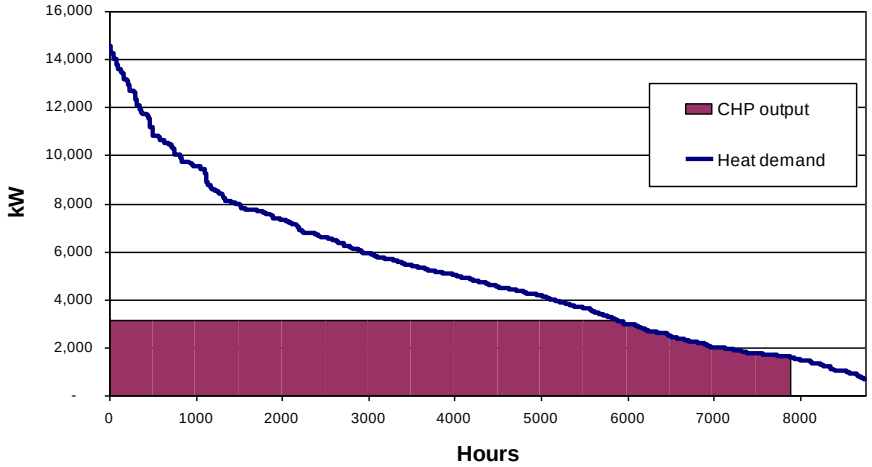
De-Risking the Project & Business Case

- Investment in biomass solutions are made through:
  - balance investment risk against operational risk

  Against
  - Economic benefits (IRR and ROCE)
- Proper and diligent investigation of Capital, Operational, Supply Chains and Technology
- CAPEX Risk Mitigation:
  - Use of Proven technologies
  - Due diligence on plant suppliers CAPEX and REPEX
  - GMP for installations
- Operational Risks Mitigation:
  - Spreading fuel risk across multiple fuel streams
  - Blending fuels and fuel switching
  - Understanding operational constraints and levers
- Economic Risk Mitigation:
  - Contractual
  - Indexation and forecasting



- For District Energy, once established and mature, the consumption and demand profile is relatively “stable”, therefore biomass can play an important component for baseload thermal energy (with conventional fuels for top-up and back-up) and/or fuel switching.

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Christchurch District Energy Scheme

- Key Customers:
  - Christchurch City Council
  - Canterbury District Health Board
  - Canterbury Earthquake Recovery Authority

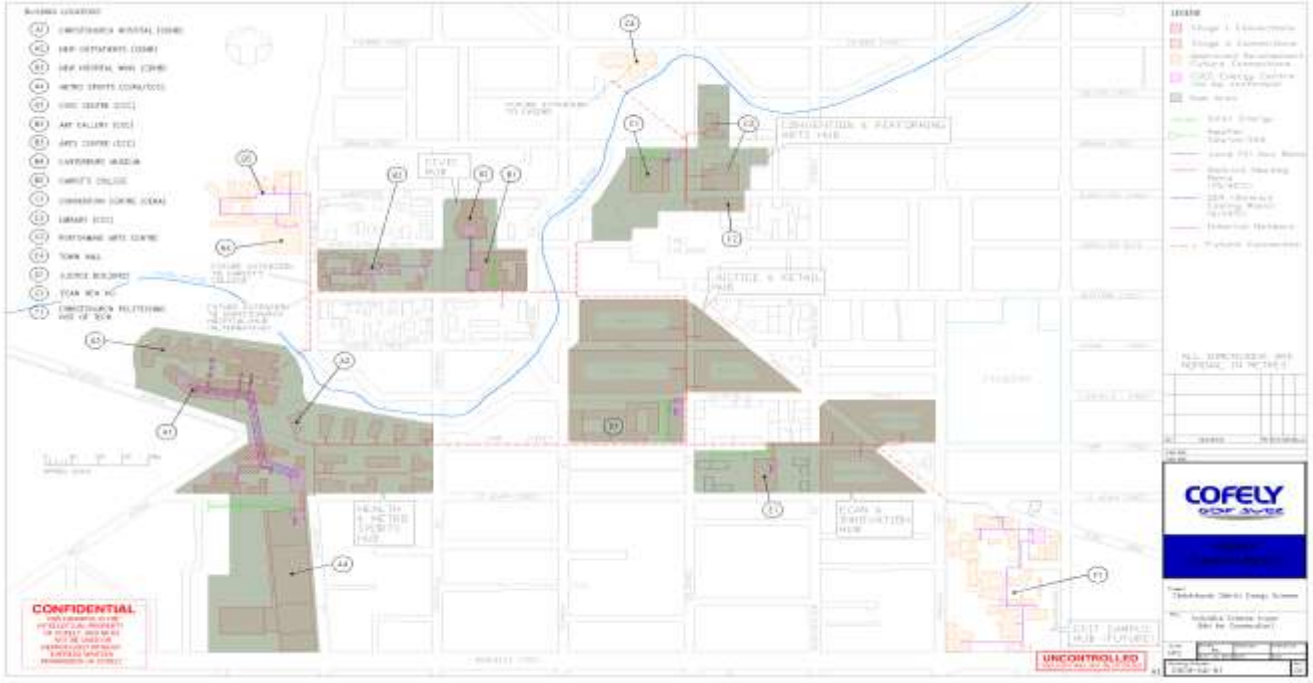
- **Cofely** is in a JV partnership with **Pioneer Generation Limited**, which has been appointed as Preferred Partners for the DES

- 30-year contract

- Road map to biomass

- Total forecast demand:
  - 17MW$_{CHW}$
  - 40 MW$_{TH}$

- Challenges:
  - Geology and stability of region
  - Energy density and proximity
  - Development risk



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