FILAMENT
ENERGY

CAPABILITIES CATALOGUE

ENERGY INFRASTRUCTURE + DESIGN

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THE HIGHLIGHTS

WHO WE ARE

Filament Energy prides itself on its solid reputation of knowledge and experience in creating custom, renewable energy solutions.

The Filament Energy team provides customers with exceptional energy-saving concepts. We work closely with you to formulate realistic plans for meeting your building or community energy requirements, and for providing the perfect solutions to satisfy your financial, environmental and social goals.

At the centre of Filament Energy is Andrew Wilcox P.Eng.. For the past two decades Andrew has been honing his craft in the district energy industry in a variety of roles including conceptual design, project management, detailed engineering, sales, and business development.

With a knack for distilling complex designs and contracts down to simple speak, Andrew is able to work with people in every level of your organization, from plant operators up to senior executives to ensure your project meets your desired goals. Andrew graduated from Queen's University with a degree in Chemical Engineering, and has pursued a number of continuing education credits in sciences, engineering and business.

WHO WE WORK WITH

Filament Energy's customer-centric approach to each project means that we can provide creative, open ended thinking to a variety of industries and property owners. Our large-scale projects are often undertaken with district energy utilities, as well as electric utilities looking to expand their service offerings or diversify energy production technologies.

We also work with public and privately owned campus facilities like colleges and universities, hospital networks, and institutional building clusters owned by federal, provincial, or municipal levels of government.

Filament also has a reputation for providing innovative approaches to energy production and consumption on smaller scale community energy systems, or even individual buildings. Our customers have included commercial, residential, institutional, and industrial clients. We welcome the opportunity to work with real estate owners, developers, facility managers and operators, condo boards, even the smallest individual home or cottage owner.
We are inspired by very large and small projects, and believe that energy efficiency and sustainability can be achieved in any size building or system.

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TYPES OF WORK WE DO

ENERGY MODELING

The thermal losses in buildings are significant energy sinks. We evaluate new and advanced technology and compare the results on a performance and cost basis to standard technologies in order to generate a detailed load profile for a building. These comparisons are necessary components of incentive programs, grants and the recommissioning of buildings.

HEAT LOSS CALCULATIONS

Understanding the energy performance of existing buildings is vital to increasing their efficiency and reducing overall energy consumption. The process of digital modelling enables us to determine how much heat is lost from a building and to calculate how much to replace by tapping into more cost effective renewable and high-efficiency energy sources.

ENERGY USE OPTIMIZATION

We at Filament Energy understand the importance of the economics around how your building functions. Our experts calculate the overall energy consumption of the heating and cooling plants and pumping systems in your existing buildings. We then employ a suitable mix of renewable and high-efficiency energy sources to optimize building performance, increase energy security and reduce dependence on imported fuels, while reducing or eliminating greenhouse gas emissions. In this way you are assured of receiving the best value for your energy dollars.

ENERGY MASTER PLANNING

Our comprehensive energy master planning approach involves analyzing all buildings in any given community for size, type, and load profile in order to assess their heating, cooling and power requirements. We provide input to building and landscape architects and urban planners to ensure that community projects maximize local energy resources while minimizing waste. The key tasks of monitoring, measuring and evaluating finished projects allow us to ensure that your energy goals are achieved.

CONSERVATION PROGRAM ANALYSIS CONSERVATION & DEMAND MANAGEMENT (CDM)

The art of a successful energy demand management program lies in balancing utility and customer needs to produce desired changes in a building's load profile. In order to update and improve programs, an effective CDM application must focus on clear conservation goals and should undergo a regular cost/benefit analysis to evaluate its economic and environmental efficiency over the long term. After determining your energy use goals, Filament Energy looks after the incentive program application and submissions for you. In this way, we can ensure that you are gaining full value from energy management activities, strengthening conservation initiatives and operating under a strategic plan for balancing your future energy requirements and consumption.

DISTRICT ENERGY DESIGN

A quality district energy design provides energy to the user from local, low-cost sources with minimal environmental impact, creating energy savings from higher overall efficiency, utilization of waste heat, and by prioritizing renewable energy. Filament Energy applies digital modelling and comprehensive data analysis to district energy design in communities such as university campuses, health care facilities and municipalities. This application enables us to locate and size the central plant and determine the layout of the distribution infrastructure and connecting buildings throughout the system.

TYPE OF WORK: DISTRICT ENERGY DESIGN

CITY OF SYDNEY, NOVA SCOTIA

MEETING FOSSIL FUEL REDUCTION TARGETS

CUSTOMER CHALLENGE

Faced with looming greenhouse gas reduction targets, one of the most fossil fuel intensive provincial electricity grids in the country, and a lack of natural gas distribution infrastructure, the Cape Breton Regional Municipality (CBRM) had identified District Energy as a priority in the City of Sydney. Filament Energy was retained to evaluate a number of possible input fuel sources, distribution piping routing, and system sizing base don the number of potential customers in the catchment area.

FILAMENT ENERGY'S SOLUTION

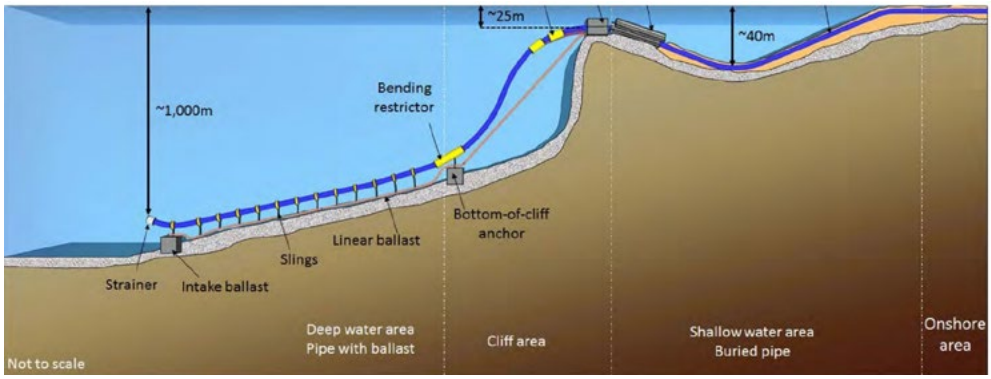
Our team evaluated a number of input fuel sources for a district heating and cooling system. Renewable sources were prioritized to improve the municipalities GHG emissions profile, and after eliminating vertical bore geo-exchange and sea water energy exchange, wastewater energy recovery was selected as the preferred energy source.

A detailed building inventory was established to determine the cumulative heating capacity required by the customer base, and to minimize the length of distribution pipework required to feed as many of the potential customers as possible. The quantity of energy available from the wastewater stream was also evaluated to ensure that peak customer loads could be satisfied during the design heating and cooling days each year.
A detailed technical and financial model was developed to take into account the construction timeline and capital costs of the central plant and distribution system, an estimated timeframe of when each customer could be connected to the system, customer avoided costs and rate plans for the new district system, future energy price projections based on utility data, and quantifying greenhouse gas emissions reductions for each customer and the system as a whole.
CBRM's overarching goals for the project were prioritized throughout the project. A renewable energy-based district system was designed to capture as many customers as possible, while at the same time creating local design, construction, and operational jobs. Filament was also tasked with taking advantage of local energy sources, reduce each customers annual operating costs by a meaningful amount, and eliminate as much of the communities greenhouse gas emissions related to fossil fuel heating as possible. The system will ultimately be financially profitable for the owner while meeting CBRM's fiscal, environmental, and social goals; a successful project by all metrics.

TYPE OF WORK: ENERGY MASTER PLANNING

NORMAN MANLEY INTERNATIONAL AIRPORT

SEA WATER COOLING STUDY, KINGSTON JAMAICA



CUSTOMER CHALLENGE

As with most other countries in the world, Jamaica has set greenhouse gas reduction targets, resulting in a need for renewable energy projects to achieve those goals. As with most other Caribbean islands, Jamaica's electricity supply is generated by burning diesel fuel supplied from all over the world. This essential process is not only environmentally damaging, but crude oil supply and price volatility are putting the affordability of electricity in jeopardy. Sea Water Cooling (SWC) targeted at government owned facilities, that are intensive cooling users, identified both International airports on the island as prime candidates for renewable technology systems. The Norman Manley International Airport (NMIA) is the first one to be investigated.

FILAMENT ENERGY'S SOLUTION

While capitally intensive, renewable energy based projects like sea water cooling systems leverage the natural cool water from deep below the oceans surface to replace electric chillers as the source of chilled water. The NMIA building, and all of its support buildings close to airport lands form the basis of a clean green district energy system. The SWC design process was comprised of on-shore, and off-shore components. The on-shore work was comprised of trenching from the landfall location of the undersea pipes to a new energy center building located next door to the airports existing chiller plant. A set of heat exchangers were designed to interface between the sea water and the airports chilled water loop. The Airports HVAC system flow rates and temperatures were measured to ensure that the SWC system was designed to be compatible.

The off-shore design work required detailed analysis of the sea bed topography, measurements of water temperature at different depths and locating a suitable path for the intake pipes that didn't' interfere with existing underwater rock formations. Appropriate intake pipe tethering and weights were designed to ensure the pipes would stay in their intended location on the sea bed, and not be impacted by severe 100 year storms of seismic events.

The NMIA sea water cooling analysis has resulted in a design that meets all the technical requirements of the airport, while providing a supply of energy that saves the customer over 10% of its cooling operating costs, significantly reduces GHG emissions, and has a reasonable construction timeline to ensure this source of renewable energy in a timely fashion.

TYPE OF WORK: ENERGY USE OPTIMIZATION

ATLANTIS BAHAMAS RESORT

CONCEPTUAL ENERGY DESIGN PLAN

ATLANTIS
PARADISE ISLAND BAHAMAS

CUSTOMER CHALLENGE

The Atlantis Paradise Island resort in the Bahamas is a full service hotel, casino, convention facility, and water park. It occupies over 500 acres of land, boasting the world's largest open air marine environment, and housing almost 10,000 visitors at any given time. With such a wide assortment of around the clock service offerings, the resort's utility bills are equally unparalleled. With over $85M USD in electricity bills per year, the resort's owners were willing to explore any possible options to reduce operating costs, particularly if a shift to renewable energy could be incorporated.

FILAMENT ENERGY'S SOLUTION

Identifying energy saving measures in a facility that has been built in four stages over the past 50 years is not a trivial task. In order to save energy we believed that we must first understand where energy is being used. Cooling plants, accommodation lighting, common space uses, including a world class casino, back of house kitchen and housekeeping uses, and marine and water park loads were identified as the major contributors to electrical consumption, once dozens of metering points had been analyzed.

With much of the resort's cooling loads driven by a year-round, warm, humid climate, mitigating air conditioning costs was a priority. Air conditioning takes almost 40% of the resort's demand for power. LED lighting retrofits were investigated, particularly for common areas of the resort that are lit 24 hours a day. An on-site bioreactor also was proposed in order to convert the nearly 10 tons of inedible organic waste generated at the resort each day into useable electricity.

As a final step, a large solar PV array, able to withstand hurricane force winds was proposed for the purpose of mitigating the amount of power purchased from the grid. With grid power produced in diesel power plants, we determined that solar panels were also an economical solution for reducing the environmental impact the resort has by reducing thousands of tons of greenhouse gas emissions each year. Our solution provided cost effective solutions that met the client's goals of operating cost reduction, in addition to providing an environmental benefit. Our focus on the social, financial, and environmental bottom line is evident in all of our work.

TYPE OF WORK: ENERGY MODELING

MENKES DEVELOPMENTS

RENEWABLE ENERGY PLANNING FOR A NET ZERO COMMERCIAL PROJECT

CUSTOMER CHALLENGE

Menkes Developments Ltd. entered into an agreement to purchase a parcel of undeveloped land in Downtown Toronto's East Bayfront neighbourhood. The entire precinct sits on the shore of Lake Ontario and is attracting environmentally conscious builders who are constructing a mix of residential, commercial, and institutional buildings. Menkes has set a goal of designing and building a Net Zero office building that either can generate any energy it requires on its own or still have the option to purchase energy from a renewable energy source.

FILAMENT ENERGY'S SOLUTION

In concert with a series of additional team members including architects, LEED professionals, environmental consultants, and energy modelers, we arrived at a number of potential energy saving measures including active window shading, triple paned glazing, double curtain wall technologies, green roof construction, and storm water reclamation for grey water usage.

Filament Energy's contribution from a District Energy perspective was a combination of on-site Geoexchange located below the building's lowest parking level, and waste heat recovery from neighbouring commercial and industrial buildings. This solution reduced the buildings HVAC energy consumption by over 90%, eliminated any greenhouse gas emissions associated with heating and cooling the building, and with HVAC loads making up over 40% of the buildings total energy use, it was the single largest contributor towards the net-zero goal.

Our solutions often extend beyond the property lines of our primary customer. This unique point of view allows us to take advantage of sources of waste and renewable energy that might not otherwise be available to the customer. Our relationships with specialized contractors, utilities, and financial investors ensure that you realize even the most stringent energy and environmental goals.

TYPE OF WORK: ENERGY MASTER PLANNING

BROOKFIELD RESIDENTIAL

BROWNFIELD DEVELOPMENT ENERGY PLANNING

Brookfield

CUSTOMER CHALLENGE

Over the past 50 years Brookfield Residential has established itself as a leader in the land development and home building industry in North America. Always striving to identify itself in the marketplace in unique ways, Brookfield Residential now is building highly efficient and renewable energy-based living spaces. In this way, the company applies the all-important principles of sustainability to its list of ethical characteristics of passion, integrity and focus on community.

FILAMENT ENERGY'S SOLUTION

With development properties located in every climate belt in North America, a blanket solution did not suit this client. Therefore, in each geographic region, Filament Energy conducted a detailed analysis of the building energy profiles to determine heating, cooling and electrical needs for each development. Once load profiles were established, a tiered approach was taken to ensure that capitally-intensive renewable energy sources were identified as base loads, with more traditional sources used for peak loads. This approach ensured that renewable energy sources were used as effectively as possible.

As geography and climate determine changes in energy demands, different technologies were suggested to best utilize locally available energy sources. Geoexchange is a logical solution for climates in which heating and cooling loads are relatively well balanced throughout the year. Off-peak chilled water production in concert with thermal storage makes sense in warmer, southern locations. Renewable power generation utilizing solar PV panels can generate clean electricity to be used in a development that may not warrant renewable thermal energy sources. Filament Energy guarantees that no matter the challenge, all environmental, financial, and social factors are taken into account when providing you with a custom solution.

TYPE OF WORK: DISTRICT ENERGY DESIGN

ENWAVE ENERGY CORPORATION

EAST BAYFRONT ENERGY PLANNING

CUSTOMER CHALLENGE

In an effort to expand its geographical reach outside Toronto's downtown core, Enwave Energy Corporation has been exploring numerous locations around Toronto to construct new district energy facilities. One promising area is the East Bayfront precinct on Toronto's east waterfront. With joint funding from Federal, Provincial, and Municipal governments, the local development corporation, Waterfront Toronto, has put a particular emphasis on the environmental performance of any building built in the neighbourhood.

FILAMENT ENERGY'S SOLUTION

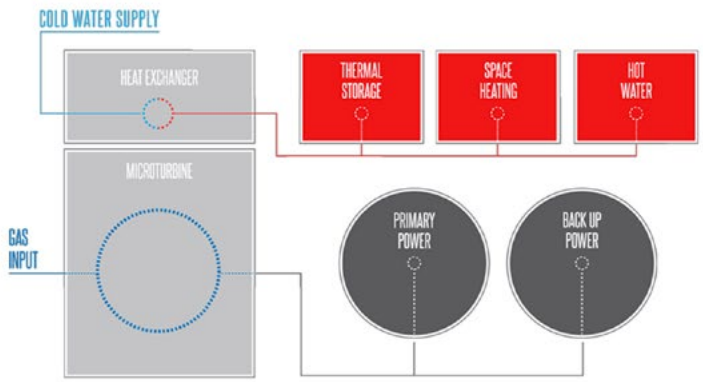
With dozens of developers and land owners working to construct a vibrant, functional mixed-use neighbourhood covering almost 60 acres of prime waterfront land, developing a scalable, functional energy system would be a challenge for even the most experienced engineers. Our solution focused on developing relationships with as many of the precinct developers as possible to gather information about the number, size, location, intended use and construction timing of any planned buildings. We then used the decades of thermal energy data that Enwave had accumulated to develop cumulative, detailed energy load profiles for the entire precinct.

Once the location and construction completion dates of each building were known, distribution piping for heating and cooling service was planned to ensure sufficient capacity would be available to all future buildings. The final step of the puzzle was to plan where Enwave could build energy plants or where waste energy could be captured and reused. While all stakeholders had a desire for renewable energy sources, it would not be financially feasible to construct these capitally-intensive projects until a critical mass of customer buildings existed. Our solution was to construct initial energy plants using less expensive, traditional heating and cooling equipment as the energy source. Once sufficient buildings had been built and occupied, renewable technologies such as Geoexchange could be implemented and the initial boiler and chiller plants could be converted to peaking plants, operating for only a few hours a year. The entire project plan would meet the immediate energy needs of the first buildings to be built, with the promise of low emissions renewable technologies to come later in the lifecycle of the precinct. Enwave's expected financial returns could be met in both the short and long term, while satisfying the environmental performance that all stakeholders desired.

TYPE OF WORK: CONSERVATION PROGRAM ANALYSIS

MAGNOLIA GENERATION

COGENERATION MODELLING + CDM APPLICATIONS



CUSTOMER CHALLENGE

Magnolia Generation, a new contender in the residential Combined Heat and Power (CHP) market, has brought an innovative service offering to high rise condo and apartment buildings. Magnolia's exclusive license in Ontario allows them to install, own and operate micro CHP plants in buildings, providing tens to hundreds of kilowatts of electrical power and heat. The small scale of these micro turbines allows Magnolia to provide base load power and thermal energy to customers, while maintaining grid power connections and existing boiler plants for peak loads. The turbines also act as emergency power generators that provide sustained occupancy levels of power and heat.

While the projects are financially viable, external funding from various sources, including low interest debt financing, demand and conservation reduction programs, and process efficiency improvement funds, augment the rates of return for Magnolia's investors.

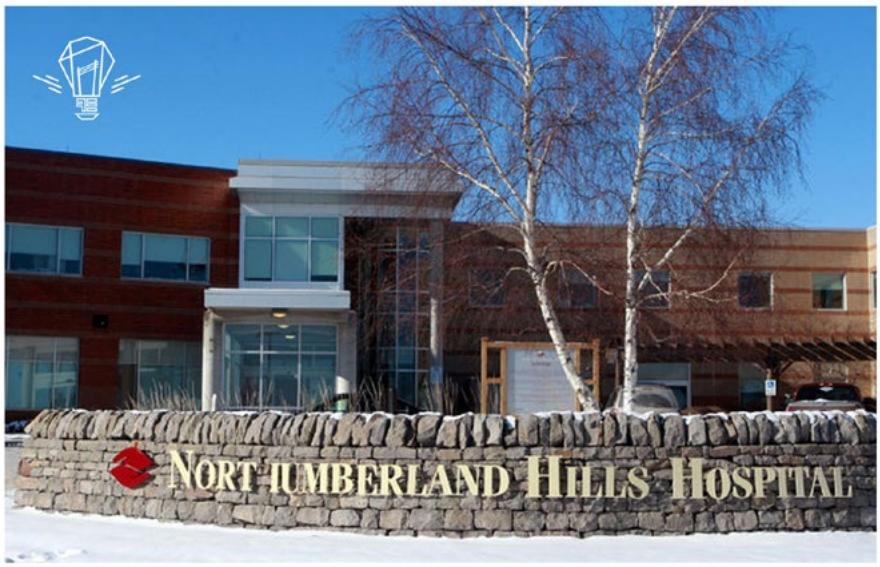
FILAMENT ENERGY'S SOLUTION

The application process for government and utility grants can be onerous for building owners or service providers to manage. With Magnolia generation operating primarily in the City of Toronto, Filament Energy proposed a cost-effective solution to provide the detailed energy model, completed application forms, attendance at meetings with the grant providers and their agents to validate collected and modelled data, and complete the subsequent measurement and verification program.

Filament's familiarity with building electrical and thermal energy systems allowed us to prepare detailed energy models, taking into account hourly utility data, ambient temperature fluctuations, seasonal demands, part load operations, and planned system downtime. This model is tailored for each of Magnolia's customers to optimize electrical and thermal efficiency, meeting the desired outcome of the grant program, and maximizing the financial returns of the project.

TYPE OF WORK: ENERGY MODELING

NORTHUMBERLAND COUNTY
COGENERATION FEASIBILITY STUDY



CUSTOMER CHALLENGE

The Economic Development office in Northumberland County is responsible for attracting new business to the area. Given the abundance of industrial land and local skilled labour, attracting new industry provides construction jobs as well as ongoing employment. Recently the County was approached by an international company that manufactures nuclear medical products that could be used locally.

Given the energy intensive nature of the potential facility's needs, Northumberland county wished to investigate if a Cogeneration plant built close to this industrial site and the local hospital could reduce operating costs for both parties.

FILAMENT ENERGY'S SOLUTION

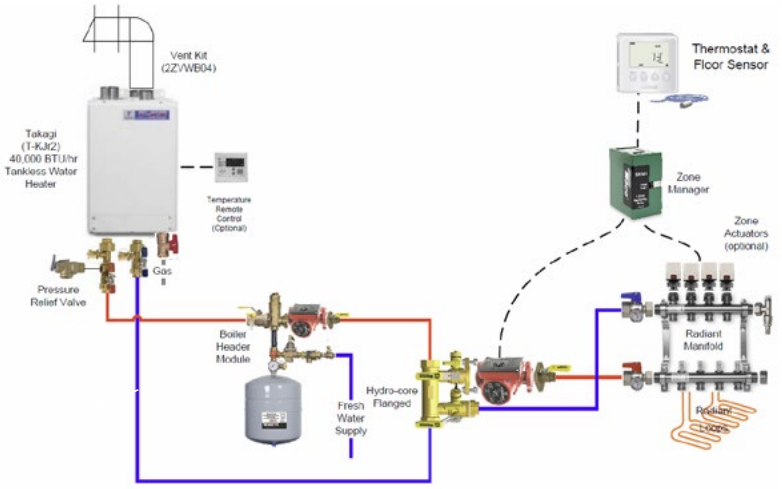
Detailed thermal and electrical load profiles were generated for this industrial customer using existing hospital data and projected production schedules. The combined loads were mapped on an hourly basis in order to determine what the maximum generator capacity could be in order to optimize the generator's efficiency.

Potential ownership structures and physical locations for installing the generators were provided to the Economic Development office for their evaluation. Detailed schematics illustrating the heating, water, steam, and electrical connections into both sites rounded out Filament's submission.

TYPE OF WORK: HEAT LOSS CALCULATIONS

PRIVATE HOME OWNER

RESIDENTIAL THERMAL ENERGY MODELING



CUSTOMER CHALLENGE

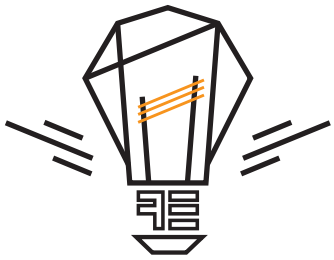
Filament Energy's client, a private home owner in Alberta, wanted to build a retirement style home in an Edmonton suburb. She desired a moderately sized one bedroom home, built on one level, that was designed to exceed building code requirements for energy efficiency, and be inexpensive to operate. To obtain building permits for a new-build home in Alberta, an energy model was required to size HVAC an instantaneous boiler to satisfy both comfort heating loads as well as domestic hot water loads.

FILAMENT ENERGY'S SOLUTION

With the 900 Ft^2 floorplan already designed, a two zone in-floor radiant heating system was selected. This ensured very high efficiency operations, a nearly silent hydronic heating system that wouldn't impede the homeowner's enjoyment of the open concept floorplan, and would not require a large, dedicated mechanical room in what is already a relatively small home.

Using the HOT2000 software package, available from Natural Resources Canada, each floor, wall, roof, window, and door element was modelled to estimate thermal energy losses on a monthly basis, taking into account historical weather patterns in Edmonton. Variations of the model were provided to the client, illustrating the utility cost savings if more or less insulation was used in wall and roof construction. Dual and triple paned windows and doors were also modelled to gauge the payback of a higher efficiency home.

Once the total energy requirements were understood and all the construction variations were agreed upon, a combination hot water boiler was sized to optimize usage patterns with the combustion efficiency of the boiler. This ensures peak efficiency of the boiler is maintained for as much of the year as possible, and ongoing variable utility costs are minimized for the homeowner.



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