
CASE STUDY – SCIENCE ADVICE WORKSHOP

RHODECAR

Creating employment through waste management

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Automated collection of household waste in a subdivision

RHODECAR:

Creating employment through waste management

Note: the facts and data presented in this case study are fictitious and should not be taken to represent actual people, countries or events.

Context

Rhodecar is a country with a population of 10 million and a per capita GDP of \$42,747, ranking it 30th in the world. It has mild summers and harsh winters, with an average temperature of -15°C from December to March. One third of the population (3 million) lives in the greater metropolitan area of the capital, Recadon. The rest of the population is dispersed in towns and villages spread over a vast area of 800,000 km² (about half the area of Québec) containing large forests and fertile plains. The main agricultural activities are intensive grain and soya production, as well as poultry and pork farming.

Historically, Rhodecar's economy has been based on the exploitation of natural resources (uranium, oil, cobalt, spring water, timber). Indeed, mining companies, whose profitability is subject to the vagaries of the market, remain a major employer in several administrative regions. Depending on the year, unemployment rates range from 5% and 12%, with a wide variability between regions. A few years ago, in the hope of creating jobs for their residents and diversifying their sources of income, several municipalities, including Annevere and Bourg de Carau, both in the Chirisain region, began investing in insect farming and outdoor tourism. In the capital and its surrounding area, the techno-industrial sector dominates the market, with head offices in the city centre and many businesses in the metropolitan area.

Rhodecar imports 50% of its food and 40% of its energy from neighbouring countries. Its inhabitants generally enjoy a good quality of life. School is free and compulsory until 16 years of age. The majority of students continue their education in public post-secondary institutions. The country advocates freedom of expression and freedom of enterprise.

Rhodecarians live under a single-chamber parliamentary democracy. Historically, power has alternated between two parties: the protectionist / nationalist Rhodecarian Party, and Change For Rhodecar, which seeks to boost employment through international trade. Two other parties were founded some fifteen years ago: Green Rhodecar, an environmental party, and Rhodecar For All, which focuses on social measures and supporting the birth rate.

The last elections led to a majority government whose main objective is fighting unemployment and the

devitalization of outlying regions. Indeed, many of the elected Change For Rhodocar members, including the Prime Minister, are from regions that are suffering the full force of the global economic recession. The Prime Minister’s home village of Outecioplou, in the Chirisain region, is currently experiencing a major unemployment crisis following the closure of a foreign manufacturing company. This closure led, directly or indirectly, to a loss of employment for almost half of the village population. Other regions are affected by similar conditions, but to a lesser degree.

Party	% Votes	Number of Seats
Change For Rhodocar (CFR)	39%	65 (52%)
Rhodocarian Party (RP)	26%	34 (27%)
Green Rhodocar (GR)	21%	16 (13%)
Rhodocar For All (RFA)	14%	10 (8%)

Rhodocar is internationally renowned for its nature and its landscapes: rolling green hills, forests rich in biodiversity, pristine lakes and streams. In the south, one quarter of the country’s land is governed autonomously by the Council of Indigenous Peoples, a governance body put in place by Rhodocar’s 21 indigenous peoples (representing close to 10% of the population), in consultation with the country’s government.

Rhodocar produces nearly 60% of its energy through six state-of-the-art nuclear power plants located 500 km outside the capital. The rest of its energy comes from the neighbouring country, Aurederia, which has the differences in elevation necessary for producing hydroelectric power. Relations between the two countries cooled seven years ago following a diplomatic incident. The situation has since improved, but relations remain strained, especially when it comes time to renegotiate trade agreements between the two countries.

Given this context, the government is actively seeking new energy sources in order to eliminate its energy dependence.



Illustration: Martin PM

PART 1 - Problem

Aware of the importance of preserving their environment, several regions are asking for a waste management centre like that in Recadon, which has been composting the capital's food waste for 25 years. Many municipalities want to rehabilitate their garbage dumps, which undermine the idyllic image of their region, in order to meet the standards of the International Outdoor Tourism Group.

The government is open to exploring new waste processing options, including in outlying regions, where the goal would be to collect waste in a group of neighbouring municipalities and process it at a single location. To do this, it plans to make a major investment of 500 million Rhodecarian dollars (RHO \$) over 4 years.

The region chosen for the pilot project is Chirisain, which is home to 1.5 million inhabitants in an area of 15,000 km² of lakes and forests. The government wants to fulfill a key promise of its election campaign: to revitalize an outlying region through the creation of sustainable, well-paying jobs. The region currently generates 720,000 tons of waste per year. The region's inhabitants do not currently sort their waste for recycling. In each village, waste is buried in landfills, an operation which costs the region the tidy sum of \$43 million RHO per year.

Following a public call for tenders, three projects were submitted to the government: one using biomethanation, another using composting and a third using gasification (see data sheets). The potential contractors opted for three different technologies, each of which appears to have its advantages and drawbacks. It is now time to choose who will carry out the project. Work should begin in the year following the signing of the service contract. With this project, government economists expect the creation of close to a thousand jobs during the four years it will take to build the plant, as well as 300 permanent jobs once it is in operation.

The Minister of the Economy, who holds a seat in one of the counties of the capital, Recadon, is in charge of the file. It is to be expected that many of the decisions concerning the development of the project will cause tensions within the Cabinet, especially between the Ministers of Transport, Tourism, the Environment and the Economy.

The Prime Minister wants to make this project possible and is seeking to arbitrate these tensions in the best possible manner. He asks his chief scientists to put together a committee of experts to inform him about the technical aspects of the project, as presented in the proposals of the three contractors, in an independent manner.

Response to the call for tenders *Waste: energy of the future for Rhodécar*. Summary prepared by the Rhodécar Ministry of the Economy.

Compostair Inc. Project: Composting with gas capture

Project leader:

Compostair Inc. is a Rhodécarian waste treatment and exploitation company. Founded 25 years ago with government support, it designed the composting-based waste management system of the city of Recadon and oversees its operation.

Project summary:

Compostair Inc. proposes to set up a large-scale composting plant for the Chirisain region, in the village of Bourg de Carau, in an isolated area currently used as a landfill site. This plant will be able to process all of the region's household food waste using windrow composting technology, and will recover the gases emitted from previously buried waste to generate biogas.

The Chirisain region will have to improve its road infrastructure for the transport of food waste to the village of Bourg de Carau. This infrastructure can also be used to transport compost to agricultural areas in the floodplains, where this high value-added organic material can be used by large grain production cooperatives or packaged for export. Once compressed, the gas recovered from the old landfill area will be used to fuel a new fleet of collection trucks.

The arrival of Compostair Inc. in the region will create sustainable, low-skilled jobs that can be filled by people from natural resource industries who are currently out of work. The transition of municipalities to sustainable development will be accelerated with the establishment of a selective household waste collection system for citizens and businesses.

Cost of setting up the plant:

- Design and installation of the composting and landfill gas recovery plant: \$82 million RHO
- Investment in natural gas distribution infrastructure: \$23 million RHO
- Investment in a fleet of compressed gas vehicles: \$10.4 million RHO
- Increased maintenance costs associated with more frequent repaving: \$15 million RHO
- Adaptation of household waste collection practices: \$15.2 million RHO
- Recurring costs: energy needs covered by the recovered gas + operating and maintenance costs of \$45 RHO/t OM (or \$11 million RHO/year).

Expected economic impact:

- 430 jobs for 5 years for the implementation of the project (100% Rhodécarian, including 60% from the capital, Recadon), and 70 jobs for running the plant on the medium term (80% local employees).
- The sale of compost will generate \$12 - \$15 /t OM depending on compost quality, for an expected annual revenue of \$2.9 to \$3.6 million RHO per year.

Response to the call for tenders *Waste: energy of the future for Rhodécar*. Summary prepared by the Rhodécar Ministry of the Economy.

Methagreen Inc. Project: Biomethanation

Project leader:

Methagreen Inc., an Aurederian company, is a key player in that country's agriculture sector. In collaboration with the Aurederian government, it set up a joint treatment system in Aurederia for agricultural waste and sewage sludge, providing large agri-food companies with access to energy resources at very competitive prices.

Project summary:

Methagreen Inc. proposes to set up a waste treatment plant using wet biomethanation, like the process used to treat agricultural waste on large farms. Adapted to a regional scale and using co-digestion techniques, the plant will be able to process all the household food waste and sewage sludge produced in the Chirisain region. It will be set up right next to the regional water treatment plant, on the outskirts of Outecioplou.

The biomethanation plant will produce heat and electricity. The electricity can be used to run the plant, the water treatment plant and a fleet of transport trucks, while the heat can be used by the municipality or the Mangemoi insect farming cooperative. If the yield is sufficiently high, an agreement could be signed with Uramine uranium mining company, which would invest in the project in exchange for access to the surplus electricity produced, at a competitive price.

Access to this resource will provide municipalities in the Chirisain region with a highly cost-efficient option for investing in a fleet of electric vehicles, allowing the transport of waste at a low cost. Municipalities will accelerate their transition to sustainable development through the establishment of a three-tiered selective household waste collection system for citizens and businesses.

Cost of setting up the plant:

- Design and installation of the biomethanation plant and adaptation of the water treatment plant: \$490 million RHO
- Investment in electrical connection infrastructure for the biomethanation plant: \$1.3 million RHO
- Investment in a fleet of electric vehicles: \$31 million RHO
- Adaptation of household waste collection practices: \$8.4 million RHO
- Recurring costs: operating and maintenance costs of \$45 /t OM (or \$11 million RHO/year), energy needs of 100 kWh/t OM, in addition to the energy needs of the treatment plant and the fleet of electric vehicles.

Expected economic impact:

- 380 jobs for 3 years for the implementation of the project (40% Aurederian immigrants), and one hundred jobs for running the plant on the medium term (70% local employees).
- Electricity production of 350 kWh/t OM, of which 50 kWh/t OM could be made available to a company, generating revenues of up to \$1.6 million RHO per year.

Response to the call for tenders *Waste: energy of the future for Rhodécar*. Summary prepared by the Rhodécar Ministry of the Economy.

Tokoflam Inc. Project: Gasification

Project leader:

Tokoflam Inc. is an Iridian consultation and operationalization company for industrial and domestic waste treatment that stands out in the global market with bold service offerings. Tokoflam Inc. is not yet present in Rhodécar or Aurederia.

Project summary:

Tokoflam Inc. proposes the establishment of a waste treatment plant using plasma torch gasification. This innovative process is still rarely used outside of Iridia. It requires complex technology to which Tokoflam Inc. holds the patents. The plant and process will be able to treat all household waste produced in the Chirisain region, as well as some of its household plastic waste.

To make the best use of the electrical energy produced by the plant, Tokoflam Inc. proposes to simultaneously design and build an auxiliary tertiary wood processing plant, which will be fully powered by the waste treatment process. Tokoflam Inc. has already approached a large forestry company which, with the help of investment at the national level, could develop its transformation activities to increase exports of finished products with a higher added value. Tokoflam Inc. also plans to transform part of its syngas into ethanol and methanol, two products with high added value. Furthermore, the company points out that this technique does not require prior sorting of household waste.

As the project will require an extremely specialized workforce, labour needs will be partly covered by foreign workers. A training program will be developed in partnership with the country's polytechnics network to build a local workforce in the medium term. The government will need to strengthen its infrastructure for the safe transport of waste within 48 hours of its collection, as well as for the regional transport of wood for the processing plant.

Cost of setting up the plant:

- Design and installation of the gasification plant: \$1.296 billion RHO
- Design and installation of the wood processing plant: \$18.4 million RHO
- Adaptation of municipal safety standards (expansion of industrial zone, possible expropriation of private land): \$16 million RHO
- Partnership with polytechnics network: \$4.2 million RHO
- Recurring costs: energy needs of 400 to 800 kWh/t of waste + 85 \$/t OM for plant maintenance and operations (or \$31 M/year)

Expected economic impact:

- 420 jobs for 5 years for the implementation of the project (60% specialized Iridian employees), and 160 jobs for running the plant on the medium term (80% local employees). In addition, the wood processing plant will create about one hundred local jobs.
- Energy production will be between 900-1800 kWh/t of waste, at a value of \$25-\$50 /t of waste, for a revenue of \$9 to \$18 million RHO per year.

Proposal costs and benefits summary tables

	Composting (\$million RHO)	Methanation (\$million RHO)	Gasification (\$million RHO)
Design of waste transformation plant	82	490	1,296
Design of auxiliary plant	-	-	18.4
Cost of adapting transport infrastructures	15	31	-
Other investments	10.4	-	16* 4.2**
Investment in infrastructure for energy transport	23	1.30	-
Cost of waste collection adaptation	15.2	8.40	0
Total investment	145.6	530.7	1,334.6

* (safety standards)

** (polytechnic program)

	Composting	Methanation	Gasification
Recurring costs	\$45 / t OM \$11 million / year	\$45 / t OM \$11 million / year	\$85 / t OM \$31 million / year
Energy requirements	0	> 100 kWh/t OM	400-800 kWh/t OM
Profit (\$million RHO)	2.9 – 3.6 /year	1.60 /year	9 - 18 /year

The current cost of waste treatment is \$16.2 million RHO per year.

PART 2 - Problem

As the project developer is being selected, commercial tensions heat up with neighbouring Aurederia.

Several mayors in the Chirisain region are disappointed with the choice of location for the plant. They had been hoping to benefit from significant land revenues and jobs. Within the municipality itself and its neighbouring villages, the population is divided: while there is some public support for the project, many citizens oppose it. Also, the village cooperative, which wanted to set up local composting of organic waste, had its project refused by the municipality on the pretext that the regional system would be up and running within 5 years.

Many citizens are concerned about the impact of the construction and operation of the plant on their quality of life (noise, odor, pollution, increase in road transport, etc.). Some are mobilizing to make their voices heard through the association Citizens for Health. In addition, there are rumours that the promised jobs will require specialized skills that few residents have.

Indigenous municipalities and villages near the project site, led by Annevere, are raising the red flag. Under the previous government, these communities had agreed on a green tourism development plan, for which the government agreed to invest close to \$600 million Rhodecarian over five years. They feel that the waste management plant project, and the infrastructure it requires, could cost the region its newly-obtained International Outdoor Tourism Group certification.

However, the government wants to quickly start building the integrated waste treatment system in order to achieve energy independence within five years.

The Minister of the Economy decides to hold public consultations to address the protests that are preventing the project from moving forward.

PART 3 - Problem

As elections are held on a fixed date, citizens are called to the polls. The election results are as follows:

Party	% Votes	Number of Seats
Change For Rhodecar (CFR)	33%	52 (42%)
Rhodecarian Party (RP)	29%	47 (38%)
Green Rhodecar (GR)	23%	17 (14%)
Rhodecar For All (RFA)	15%	10 (7%)

As they have lost their majority, Change For Rhodecar decides to form an alliance with the Green Rhodecar party to form the new government. The incumbent Prime Minister and leader of the Change For Rhodecar party holds onto his position as Prime Minister. He keeps his very efficient Minister of the Economy by his side. Meanwhile Green Rhodecar has secured what it considers to be two key ministries: the Ministry of Health for the party leader (elected in the capital, Recadon) and the Ministry of the Environment for the deputy leader (elected in Annevere).

The Green Rhodecar party made strong electoral gains on the strength of one of its key promises: a review of the government's environmental policies and, in particular, a review of its waste treatment plant project.

The Prime Minister and his team are forced to review the waste treatment plant project in light of the new composition of the Cabinet.

(Document not provided to participants)

PART 1 – Procedure:

- Introductions
- Distribution of roles and information sheets
- Simulations:
 1. The Chief Scientist is tasked by the Prime Minister to evaluate the technological aspects of each project, a mandate that is quite limited as it does not include social and economic aspects in the evaluation. She chairs the first meeting of the committee, which is made up of three experts. Each expert will have a few minutes to comment on the three technologies from the point of view of his/her area of expertise, and then the Chief Scientist will lead a discussion on the recommendations that should be made to the Deputy Minister.
 - Chief Scientist
 - Infrastructure researcher
 - Environmental researcher
 - Process chemistry researcher
 2. This project sparks public debate, especially the choice of location for the plant. How was this location chosen, and by whom exactly? Nobody seems to have a clear answer to these questions. A researcher gives an interview on Chirisain regional television, to take a position on the choice of location.
 - Public health researcher from the greater Chirisain area
 3. The Chief of Staff and Deputy Minister meet with the Minister of the Economy to take stock of the situation.
 - Chief of Staff
 - Deputy Minister

(Document not provided to participants)

PART 2 – Procedure:

- Distribution of roles and information sheets
- Simulations:
 1. The Ministry of the Economy launched a series of regional consultations, focusing on the regions where there was greatest opposition to the project. In the absence of the Economy Minister, who is busy preparing for upcoming economic negotiations with Aurederia, the Chief of Staff attends some of these consultations, including the one in the Chirisain region. The participants take turns presenting their points of view, and also challenging each other:
 - *Citizens for Health* association
 - Mayor of the chosen municipality
 - Manager of the largest fishing outfitter in the region
 - Representative of the developer chose following the call for tenders
 - Economics researcher
 2. That same evening, the Chief of Staff briefs the Minister of the Economy on the outcome of the consultation, knowing that she will have to answer questions the next day at a media scrum or during question period in parliament.
 - Chief of Staff
 - Minister of the Economy
 3. Media scrum with the Minister of the Economy: the Minister is asked to respond succinctly to brief questions of all kinds.
 - Minister of the Economy

(Document not provided to participants)

PART 3 – Procedure:

1. Distribution of roles

1. Prime Minister (CFR)
2. Minister of Transport (CFR)
3. Minister of Municipalities (GR)
4. Minister of the Economy (CFR)
5. Minister of Public Safety (CFR)
6. Minister of the Environment (GR)
7. Minister of Health (GR)

2. Simulation

To prepare his Cabinet, the Prime Minister summons some of his ministers in order to find ways to come to an agreement.



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