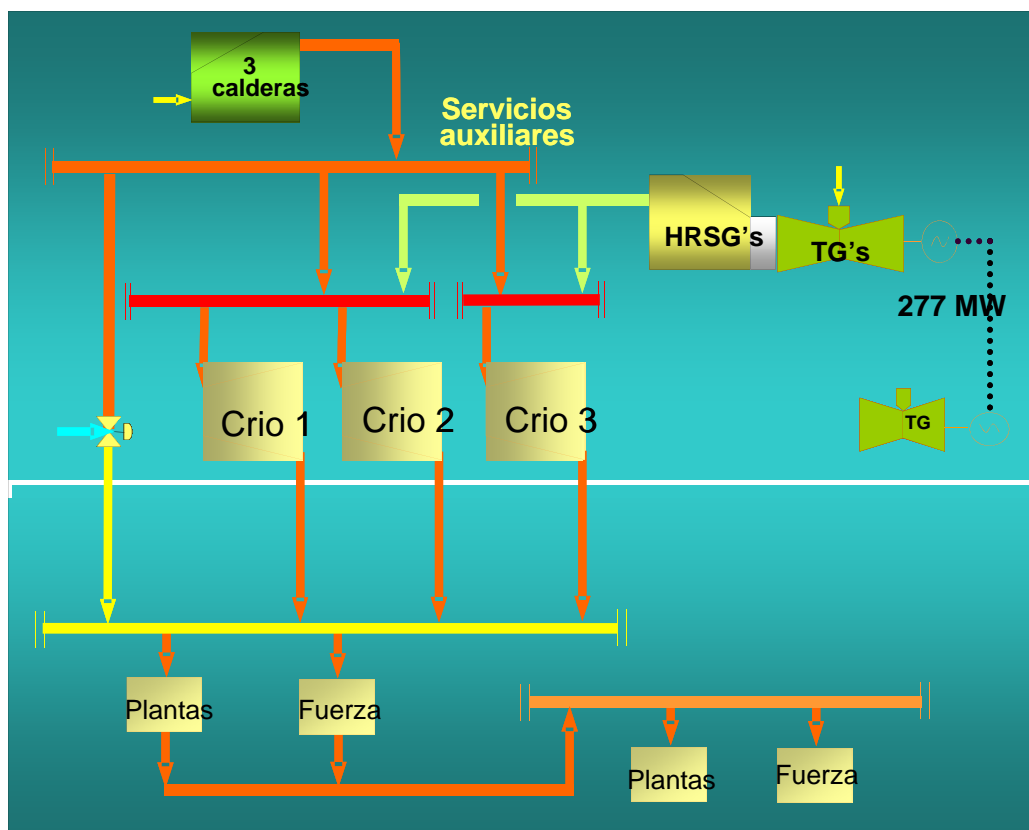




Efficient Cogeneration

Nuevo Pemex

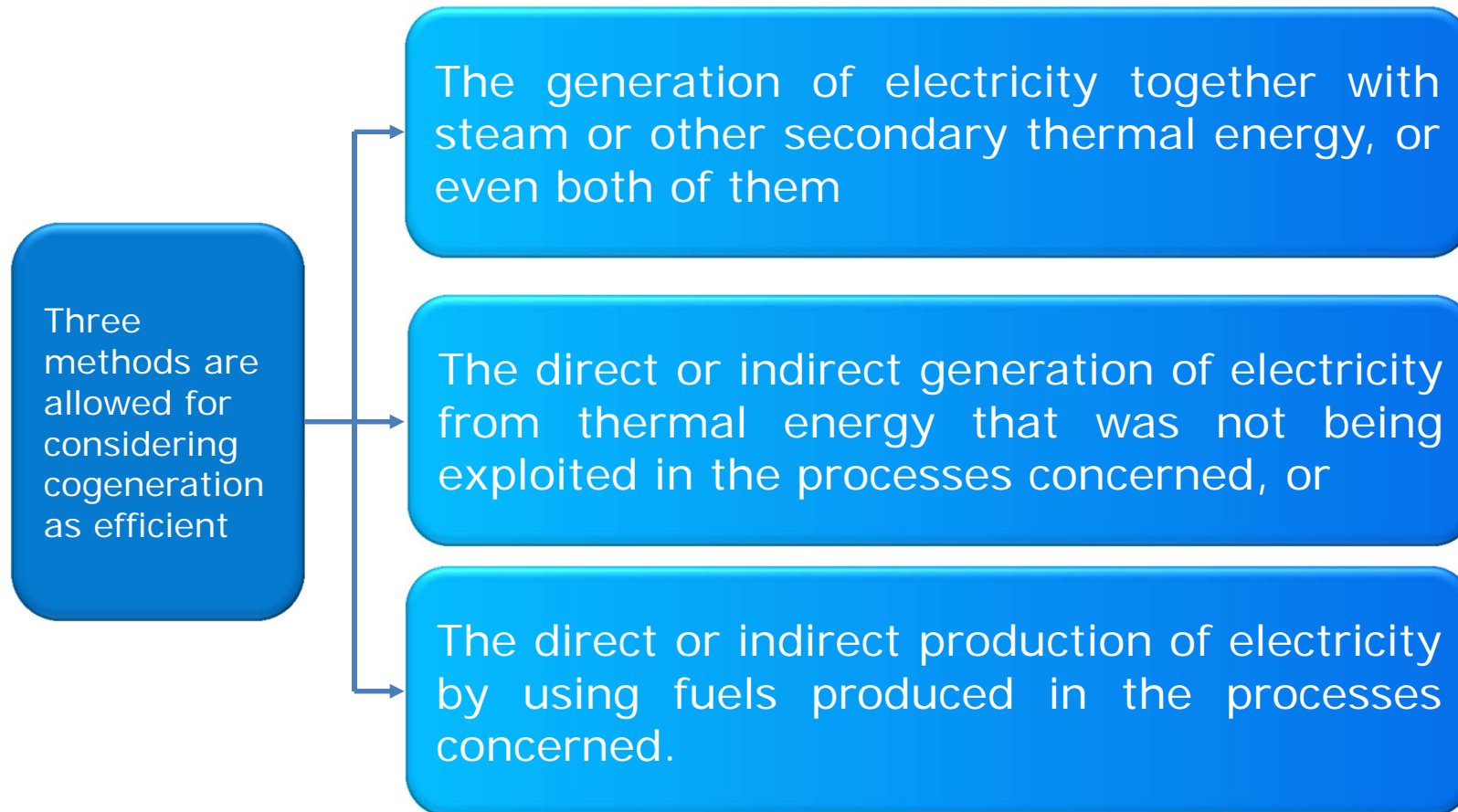
Operational Scheme for Steam and Electrical Power for Nuevo Pemex Cogeneration Plant



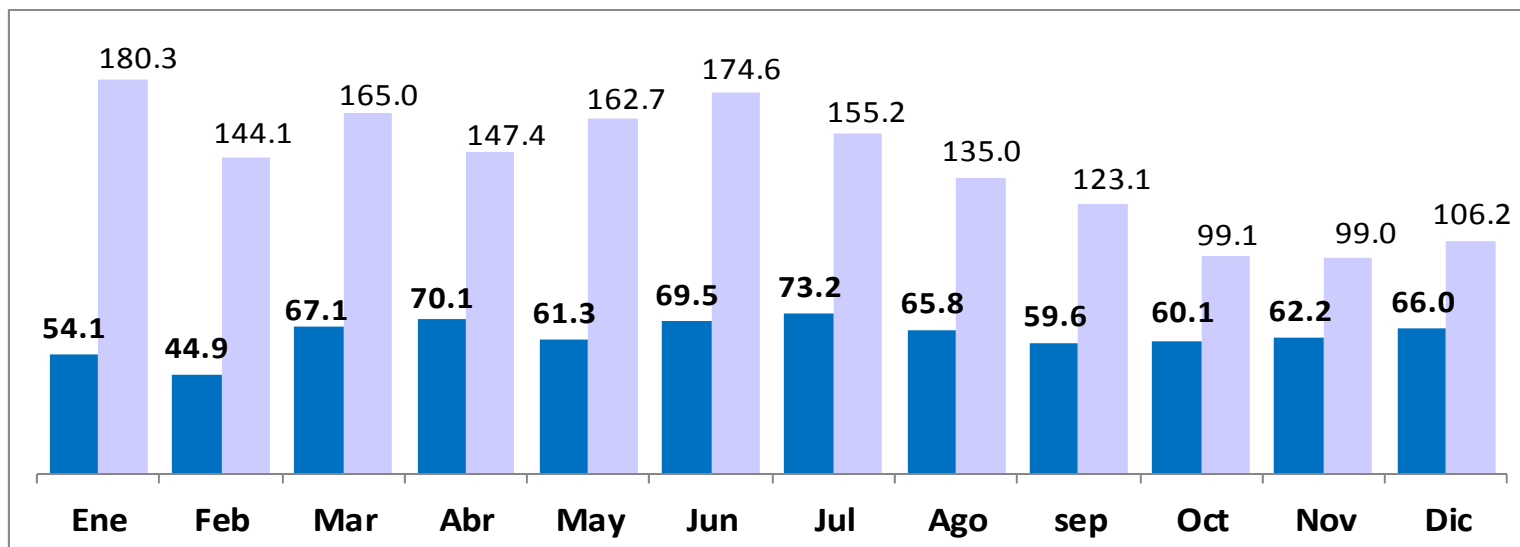
- Cogeneration achieves combined efficiencies of at least 80%.
- For the case concerning us, where the local exergy study indicates that 64% of the primary energy is used to generate electricity, the equivalent efficiency of electric power is: $80\% \times 0.64 = 51.2\%$
- The average efficiency previously achieved was around 28%
- The operation scheme consists of the cogeneration with two gas turbines and two heat (HRSG) recovery
- The process makes use of natural gas and water to produce steam and electricity.
- A service provider has the contractual responsibility for installing the Cogeneration Plant, as well as performing electricity generation.
- PEMEX provides only water and fuel gas, receiving steam at the location and electrical power for internal consumption and to be deposited at the electrical network, for delivery to several other Pemex sites.



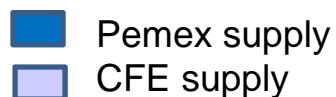
Regulator rules for Efficient Cogeneration



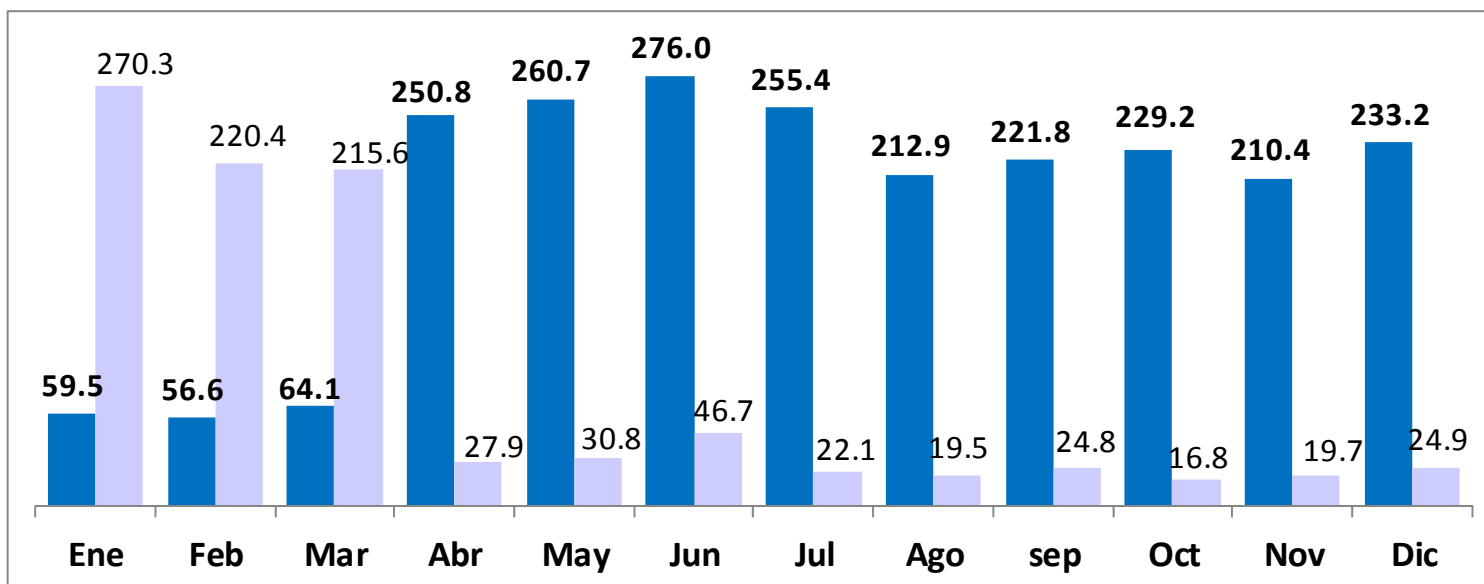
Daily consumption (MW)



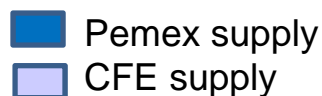
- PEMEX was operating with 86 remote consumption centers receiving electrical energy from 11 generation sites, whose average efficiency was of 28%.
- By the end of 2012, most of these sites ceased their operation, since none of them fulfilled the conditions required for efficient cogeneration.
- On this scheme an average of 63 MW were produced by Pemex, while 138 MW were bought from CFE



Daily consumption (MW)



- Nuevo Pemex started its commercial operation on April 2013. It operates with 180 remote consumption centers demanding an average generation of 239 MW capacity, reducing the volume purchased from CFE.
- In order to allow Pemex to take advantage of the whole installed capacity at Nuevo Pemex by further reducing purchases from CFE, currently the proper paper work is taking place with the regulator (CRE) and the state power company (CFE) to increase both the number of remote consumption centers and the amount of energy that may be transferred to each one of them





Efficient Cogeneration Benefits

Each month the regulator authorizes transmission costs for three types of consumption centers: high-voltage, medium voltage and low voltage. This mechanism contrasts with the rates for CFE which are also determined by voltage level, together with the demand period. July 2013 rates for transmission costs in pesos were:

Time Period	CFE Cost* (\$/kWh)	Level	Transmission cost \$/kWh	Total cost of Nuevo Pemex
Base	1.022	High	0.0337	0.817
Intermediate	1.227	Medium	0.0674	0.851
Peak	2.053	Low	0.1347	0.918

Around 80% of Pemex consumption occurs at high tension level for which there is a differential of 3 to 4 cents between CFE rates and CRE approved rates for Efficient Cogeneration for each kWh.

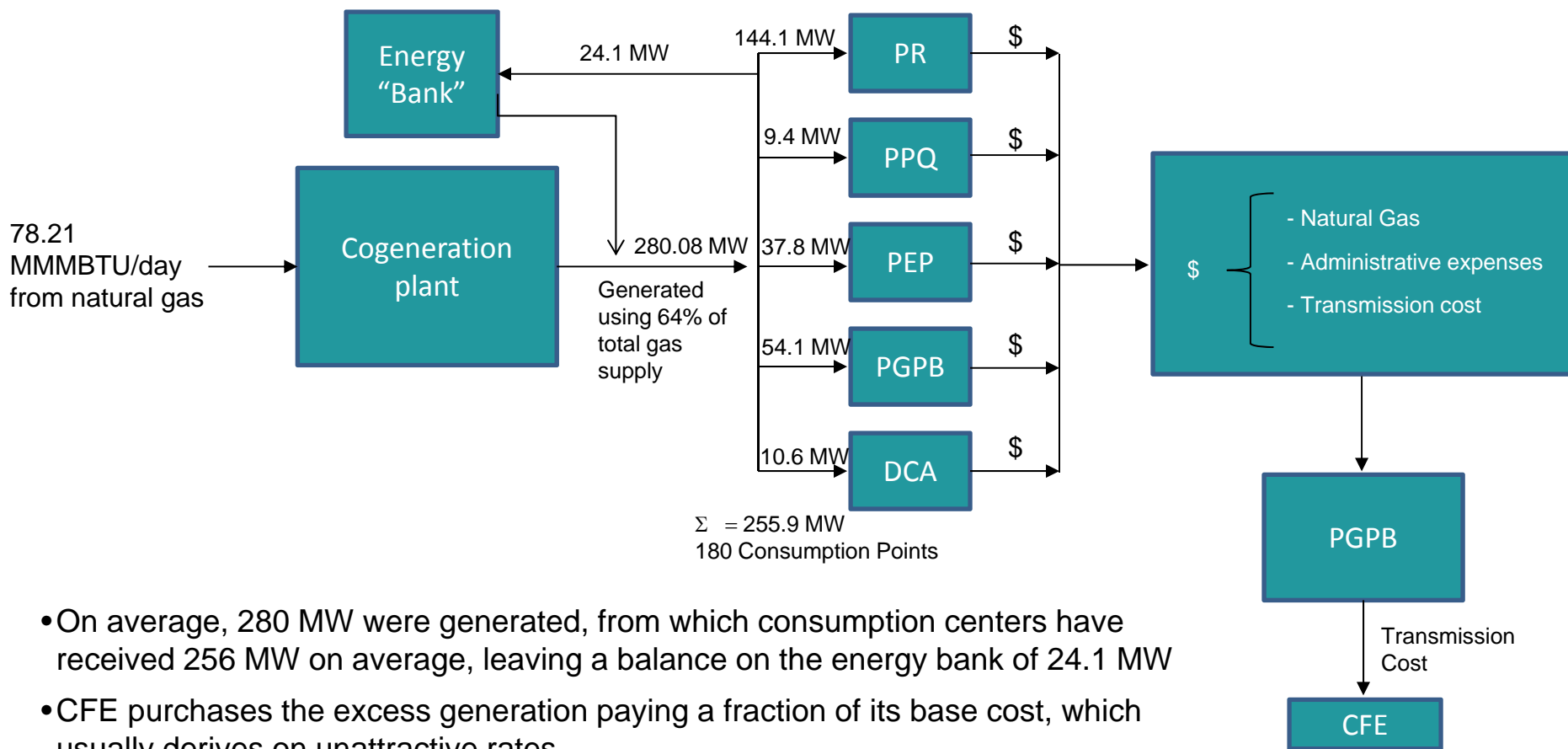
Given current CFE costs and policies, there is another benefit which comes from capacity recognition. The savings compared to CFE cost can account up to 90% of 120 or 180\$/kW , depending on the tension level.

These two benefits combined with and the efficiency increase, are enough to pay back for the project investment. Given the current estimates, the expected pay back period is less than five years.

* Average cost on Pemex sites



Nuevo Pemex Operation 2013*



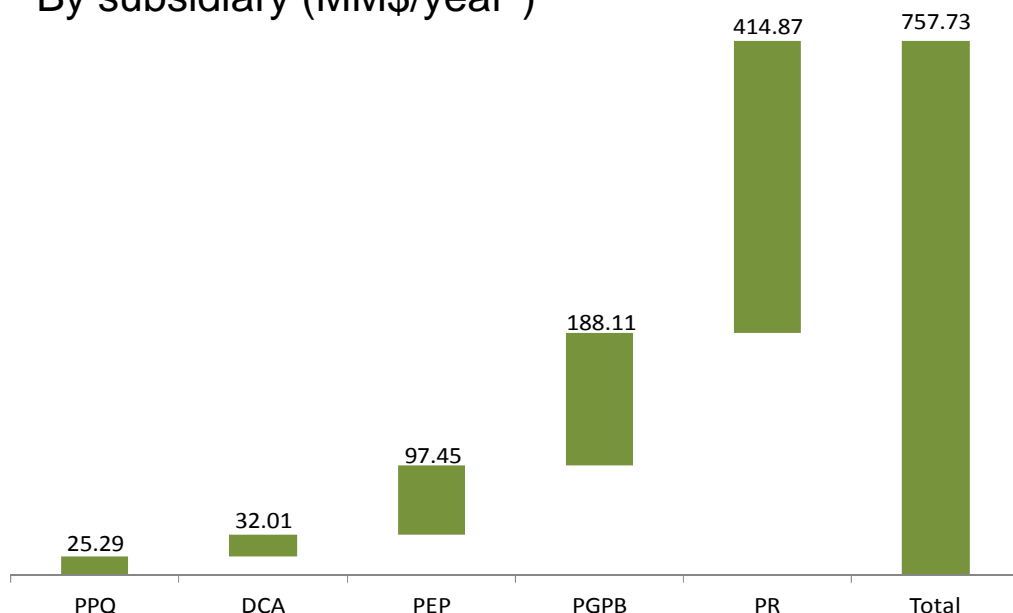
- On average, 280 MW were generated, from which consumption centers have received 256 MW on average, leaving a balance on the energy bank of 24.1 MW
- CFE purchases the excess generation paying a fraction of its base cost, which usually derives on unattractive rates.
- Penalties are applied on cases where the third party (supplier) uses more fuel gas and/or generates less electricity than the guaranteed level.

* Average April – December 2013

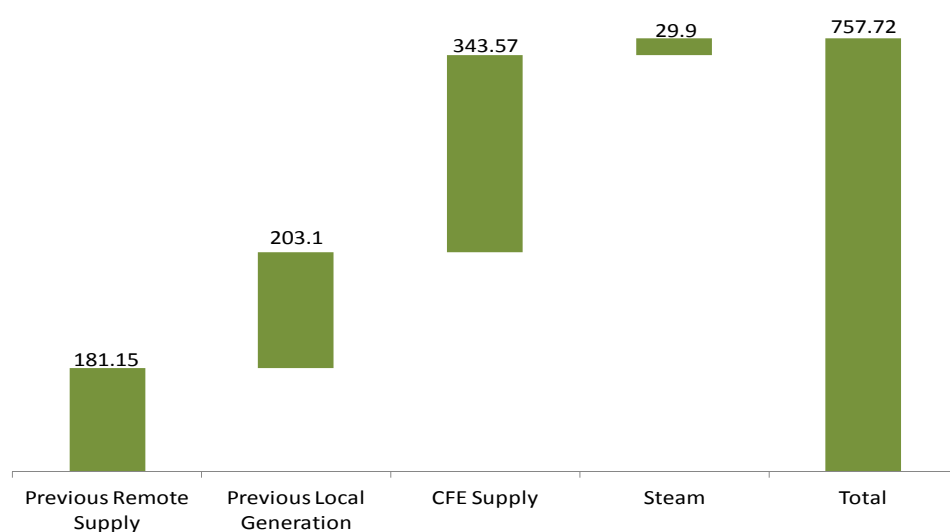


Estimated savings

By subsidiary (MM\$/year*)



By concept (MM\$/year)

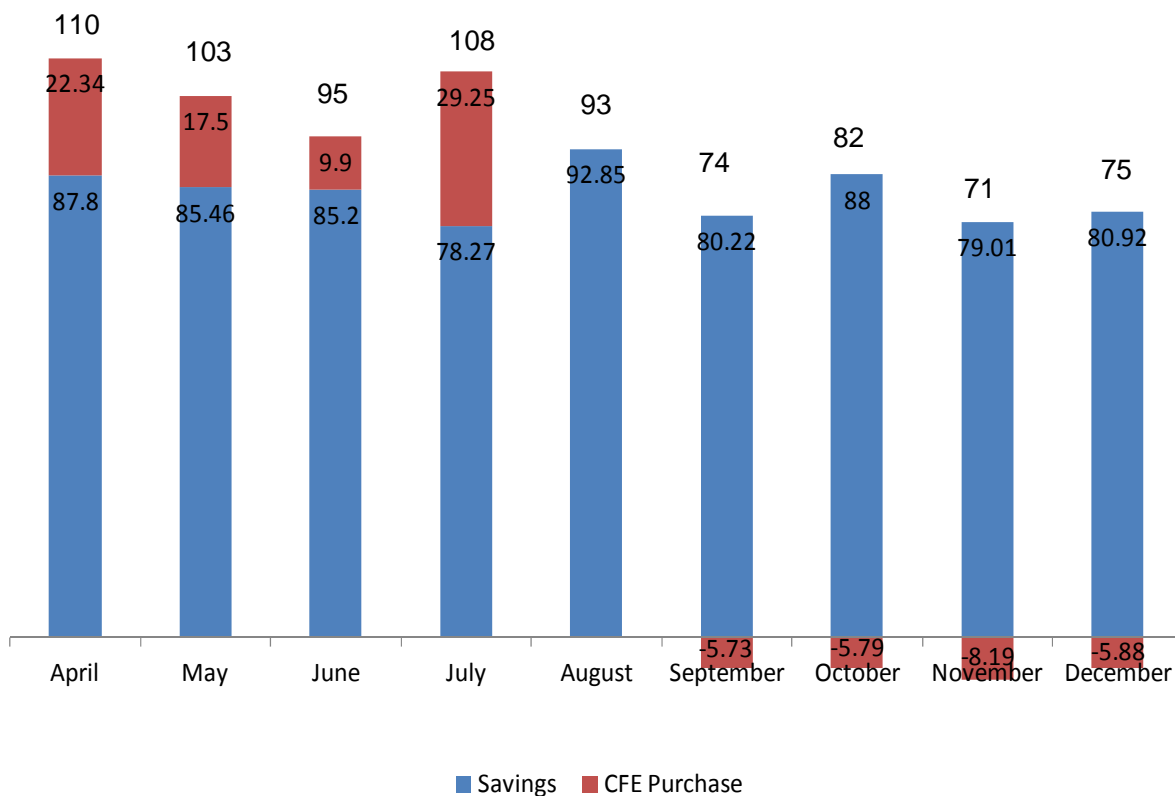


- PEMEX Refining is the subsidiary with the highest economical benefit from this project.
- PGPB, the subsidiary owner of the host center Nuevo Pemex; because of its competitive generation costs in Cactus and Ciudad Pemex and steam in Nuevo Pemex lower benefits can be observed.
- PEP saving compared to previous handling, is explained by the lower rate realized compared to its own generation and the cost of energy purchased from CFE.
- DCA and PPQ have lower savings, derived from their reduced consumption level. PPQ also had competitive cost of generation in some sites.



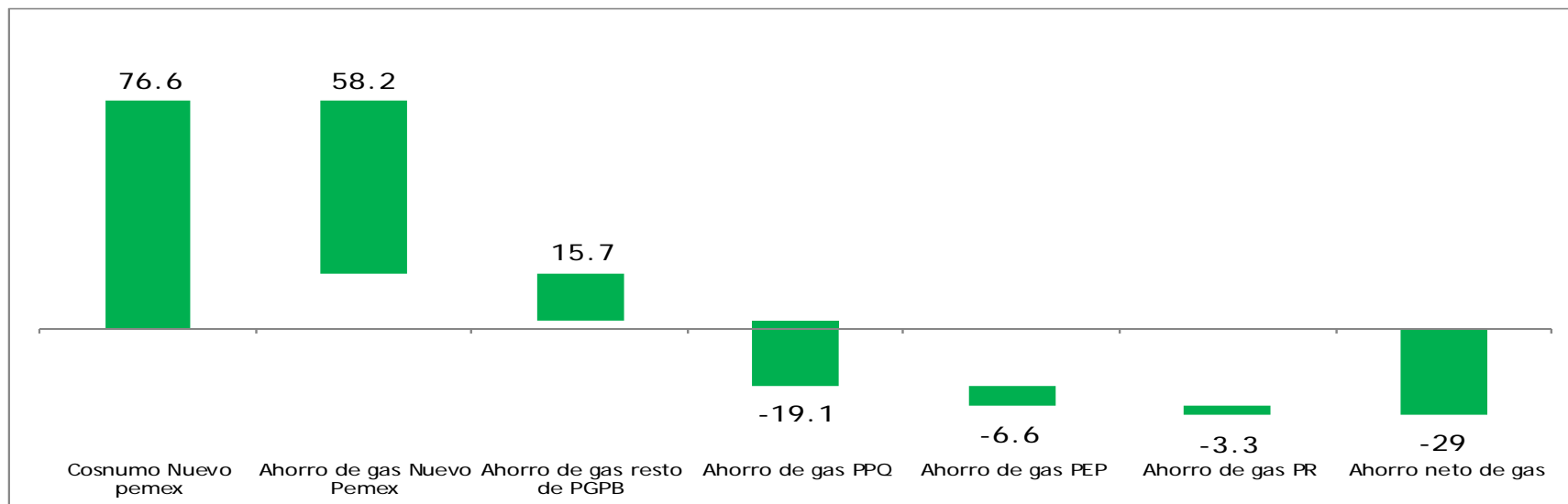
Monthly savings

Monthly Savings (MM\$)



- Pemex benefits on average are 90 million pesos per month.
- The main objectives of this project were to increase efficiency and reduce costs, both of which have been achieved.
- Additional optimization, given the regulation and contractual conditions with the CFE are being undertaken which is expected to increase these benefits in 10 to 15%.
- On the other hand, the “Energy Banking System” which provides many benefits to intermittent energy sources, has proved to cause losses in Nuevo Pemex, given the low prices being paid by CFE for the surplus power.

Net Benefit for Natural Gas Balance (MMCFD)



- The gas saving from the project is close to the 30 Mmcf/d, achieved mainly by the reduction in fuel consumption at CPG Nuevo Pemex and Pemex Petrochemical Generation Plants. This 29 Mmcf/d and a small decrease in consumption of fuel oil are equivalent to reducing emissions of 430 Mton/year of CO₂.
- Additionally, the decrease in purchases to CFE by 110 MW, considering its lower average efficiency level for generation (reported by CFE at 41%) allows saving around 380 Mton/year of CO₂ for the efficiency increase being allowed to the system.



Emissions reduction

- In a direct way, Nuevo Pemex Cogeneration Project generates a positive environmental impact (430 Mton/year) equivalent to removing 63 thousand cars, which is equivalent to all cars in the municipalities of Zacatecas, Zacatecas or Guadalupe, Nuevo León. However, this figure only represents 1.5% of cars nationwide
- It is estimated that the environmental benefit of the project is equivalent to planting 107,000 acres of trees each year the project operates.
- By exploiting the full potential of Cogeneration at Pemex, the environmental benefits would exceed by far the effects of national reforestation annually. We are seeking to sell the bonds in secondary markets.

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