# INITIATIVE TO IMPROVE APPROACH TO ELIGIBLE ELECTRIC ENERGY PRODUCERS

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## *ABSTRACT*

*Laws and regulations in Croatia stimulate eligible producers by means of an incentive tariff system for electric energy generation from renewable energy sources and cogenerations (**hereinafter: RES**) only if the energy is delivered to the network. That causes many problems in case of an "eligible producer who is also a consumer".*
*The purpose of the article is to initiate an improvement of existing approach to eligible producers. New approach should allow the eligible producer who is also a consumer, to get the incentive tariff for all produced electric energy, including for electric energy consumed on site.*

## INTRODUCTION

The first package of regulations stimulating energy production from RES (**hereinafter: incentive regulations**) [3], [4] and [5] was adopted in Croatia in the year 2007.
Application of first package of incentive regulations indicated some shortcomings and incompletenesses; primarily because the existing energy regulations [1], [2] haven't been adjusted to RES. Observed deficiencies should produce guidelines for further improvements of incentive regulations. First expected focus of further improvements is harmonization of the entire energy legislation with the new circumstances that have been introduced by RES. Second focus is improving the incentive regulations, including the regulation of special cases. In the year 2011 Croatia will adjust its energy laws to the third package of EU directives. Many amendments to existing energy laws are expected. Changes of incentive regulations will be implemented in the first draft of the new RES law.
This paper highlights one special problem: case of an Eligible Producer who is also a Consumer (**hereinafter: EPC**). The article presents one of many possible ideas for solving this problem. The article elaborates the idea, goals, technical solution and network connection schemes. The article presents how the new approach meets requirements of EPC, system operator, commercial sector and the energy strategy of Croatia. The goal of this article is to contribute to the improvement of incentive regulations in Croatia.

## EXISTING APPROACH TO ELIGIBLE PRODUCERS

First package of incentive regulations stimulate only produced electric energy delivered to the network. This approach initiated many questions, such as: Does energy become renewable only when delivered to the distribution system operator's (**hereinafter: DSO**) network? According to the law, the energy consumed on site isn't consumed nor produced? Aren't losses minimal in case of energy consumption on site?
The existing approach causes problems for EPC because in order to get incentives it is forced to deliver all its produced energy to network despite its consumption on site (Fig. 1).

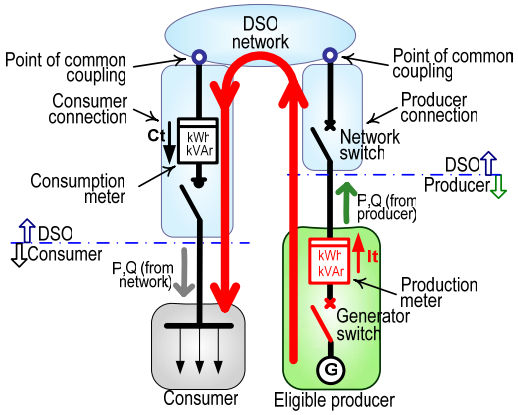


Figure 1: Present situation

At the same time distributed generation (**hereinafter: DG**) changes the usual concept of distribution network, especially in the radial parts of network. DG inverts the energy flow and increases loads in parts of network poorly loaded before DG.

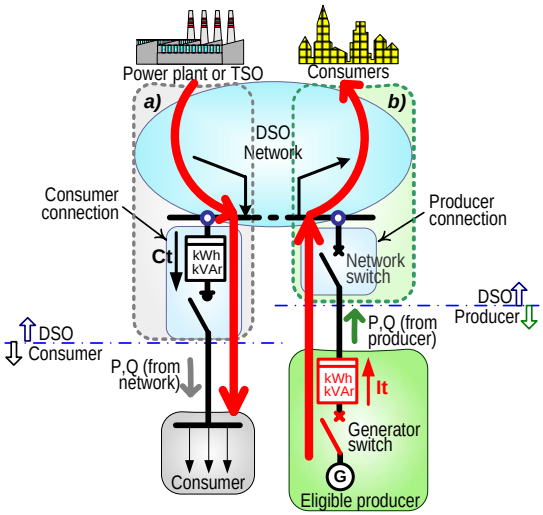


Figure 2:Creating the necessary conditions in the network

The existing approach (based on incentive regulations) requires unrealistic technical requirements on the network:
a) the network must have capacity and ability to deliver to the EPC the total energy EPC consumes ((a) in Fig. 2),
b) the network must have capacity and ability to evacuate from EPC the total energy EPC produces ((b) in Fig. 2),

c) the network is loaded only by a difference between produced (b) and consumed (a) energy. This is the most obvious when the production and consumption are well-balanced (or balance can be achieved).
It is important to note that the requirements in a) can be significantly different than the requirements in b).
The incentive tariff only for produced energy delivered to the network implies that consumption on site isn't stimulated. This disables the essential principle of DG - to disperse production, ensuring the production close to consumption and thereby unload the network and reduce losses in network.
It is necessary to stimulate the optimization of power flows in the network by encouraging coordination of DG with the appropriate (in space and time) local consumption.
First and the easiest of many possible solutions is balancing/coordinating consumption with production within the internal network of consumer that has a power plant. The proposed solution presents the producer's (EPC's) best interest. It gives DG a chance to take over its part of responsibility for the optimal system operation and become a credible energy entity contributing to system stability and optimal network configuration.

## INITIATIVE TO IMPROVE EXISTING APPROACH TO ELIGIBLE PRODUCERS

The existing approach stimulates only produced energy delivered to network. The goal is to develop a concept that will enable the EPC to receive incentive tariff for electricity consumed on site as well. The idea is to give a producer a chance to reduce unrealistic requirements on the network by locating a producer's electricity meter in producer's installation on optimal location between the generator switch and the network switch. The network switch is on the point of common coupling (**hereinafter: PCC**).
The proposed approach should fulfill the following objectives: simplicity of concept and configuration of PCC, comprehensiveness (applicability), requirements on the network reduced to realistic level, to satisfy specific network user's needs - network user is electricity producer and/or consumer (**hereinafter: NU**), relations NU-DSO independent of producer's eligibility, to initiate minimal changes in existing regulations.
In the existing approach there are two separated PCC and corresponding metering points: one for producer and one for consumer (Fig. 1). In the new approach (Fig. 3) there is only one PCC with one network's electricity metering point (**hereinafter: NEM**). The innovation lies in the eligible producer's electricity metering point (**hereinafter: PEM**). Each producer connected to the network must have the NEM, but EPC may have two meters: NEM and PEM.

### Eligible producer's electricity metering point-PEM

PEM is located between the generator switch and network switch, on the optimal location for producer (Fig. 3, 4).
If located on PCC, functions of NEM and PEM are incorporated in one metering point (NEM). This is optimal if producer isn't a significant electricity consumer or can not coordinate its consumption with its production.

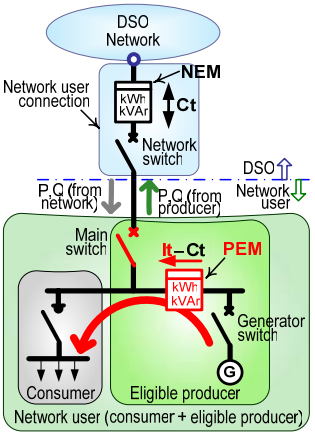


Figure 3: Proposed solution - additional option

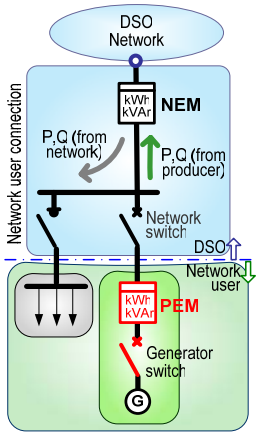


Figure 4: Isolated operation isn't possible

PEM is the basis for metering electricity produced from RES and for receiving the incentives in accordance with the Contract for the Purchase of Electricity signed between an eligible producer and the Croatian Energy Market Operator (**hereinafter: HROTE**) [1].
The number and allocation of PEM shall be agreed by the producer and HROTE. The producer that has several electricity production units based on different RES and has the status of an eligible producer for each of them, may have a separate PEM for each production unit with only one PCC and one NEM (Fig. 5 and 6). This is not possible under the existing laws and regulations.
All relations between a producer and HROTE, as well as possible changes of relations (e.g. different contribution of non-renewable sources in produced electricity) should be regulated at the PEM, which has nothing to do with the DSO. Therefore, PEM should be owned by the producer.

### Network's electricity metering point-NEM

NEM is located at the point of separation of ownership between NU and DSO. NEM meters electricity produced by NU delivered to network and electricity delivered from the network to NU. The connected power in both directions is defined by the NU's request for connection [1]. The appropriate technical solution for connection, configuration of PCC and necessary technical requirements is defined by DSO's Connection Approval. DSO's network is equipped to satisfy requested connected power in both directions.
NEM is the point of interaction between NU and DSO. Relations between NU and DSO are regulated [1] by the Use of Network Contract signed between DSO and NU. NU's electricity consumption is regulated by the Supply Contract signed between the Supplier and NU.

### Proposed method of calculating produced and consumed electric energy

The proposed method of calculating electricity produced by EPC (if there are both NEM and PEM) should fulfill the

following objectives:
- for produced electricity delivered to the network, EPC should receive the full amount of the incentive tariff,
- for generated electricity consumed on site, EPC should receive the full amount of the incentive tariff minus the consumer tariff, as if producer delivered produced energy to the network and then purchased it back for its own use.

Defined objectives outline the proposed method of calculation where $I_t$= incentive tariff, $C_t$= consumer tariff.
The tariff for energy measured at PEM (red in Fig.3) is:

$$PEM_t = I_t - C_t \quad (1)$$

The tariff for energy measured (in both directions) at NEM (black meter in Fig. 3) is:

$$NEM_t = C_t \quad (2)$$

For **produced electric energy consumed on site EPC receives the incentive tariff minus the consumer tariff** (1) - for energy measured at PEM. This is almost the same as if producer delivered produced energy to the network and then purchased it back for its own use.
For **produced electric energy delivered to the network**, **EPC receives the incentive tariff**:

$$PEM_t + NEM_t = (I_t - C_t) + C_t = I_t \quad (3)$$

for produced energy towards the network measured at PEM and measured at NEM. It makes the full incentive tariff for all produced electric energy delivered to the network.
For **purchased electric energy from the network, EPC pays the consumer tariff** (2) for energy delivered from the network measured at NEM.
The proposed method is simple because it doesn't introduce new tariffs hence the new calculating principle is easy to implement. The proposed solution simplifies the network and EPC connection facility because there is only one connection to network (one PCC and meter on PCC) instead of two. The proposed approach solves elaborated problem that isn't solved by the existing incentive regulations.

## Requirement: Parallel operation

In order to get incentives, the eligible producer has to be connected to the DSO's network. Parallel operation with the system is the simplest confirmation of quality of produced electricity. Meeting the requirements of a proper parallel operation ensures that the quality of produced electricity is in accordance with the DSO's grid code [2] and other standards.

## New possible options of network connection

Figures 3 to 6 present the different possibilities of connecting EPC to the network. If the producer looses eligibility, NEM and PCC remain the same, only the metering and payment at PEM stops (if PEM existed as a separate metering point).
It is possible for EPC to supply its consumption by its production in an isolated operation (Fig. 3, 5 and 6).
A different solution of network connection applies if the EPC doesn't want its consumption to depend on the reliability of its production. Then, in case of outage of its power plant, its consumption is supplied directly from the network (Fig. 4).
The idea of a complex power plant is introduced: complex power plant has one connection to network, one PCC and NEM, and has more than one PEM (for each generator, or a group of generators, by different incentive tariffs) (Fig. 5).

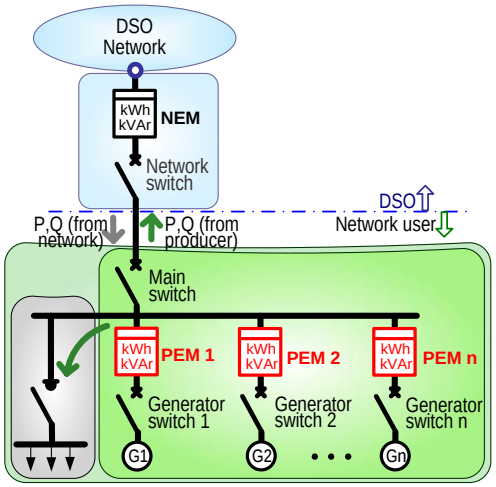


Figure 5: Complex power plant

The complex power plant can have a shared consumption (Fig.5) or not (Fig. 6). Figure 6 gives a solution for complex power plant having separate and remote generators.

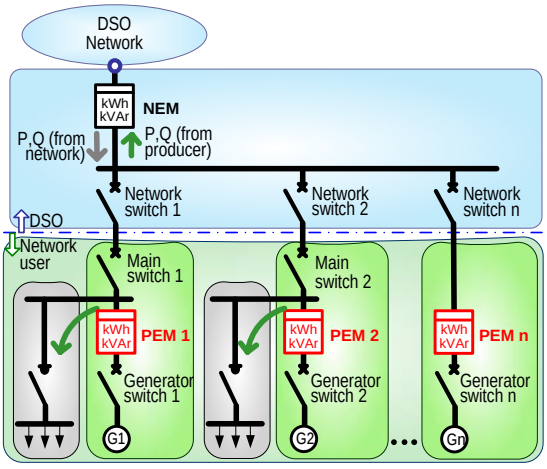


Figure 6: Complex power plant, separated consumption

Each complex power plant can be divided into many "simple" ones, each "simple" power plant has its own PCC and NEM, which puts us back at the beginning (Fig. 3, 4).

## BENEFITS OF PROPOSED APPROACH

The proposed approach gives EPC the choice - to consume produced electricity on site (in part or in full), or not, without any risk of losing incentives.
The proposed solution simplifies the network and EPC connection facility because there is only one PCC instead of two. It makes the initial investment in network connection lower, especially in countries with "deep" integration, as in Croatia. It directly stimulates eligible producer to consume energy on site, or, in reverse, stimulates energy production

in the consumption center. That is the ultimate energy policy goal – there are no electric energy transport costs, because there is no electricity transport at all.

The proposed idea provides a solution for connecting relatively "large" producers to the "weak" network because in this case they just need an adequate consumer on site.

The proposed approach also solves the problem of micro power plants - consumer's network connection (PCC and NEM) can be used for connecting a consumer's micro power plant (instead of two PCC as in existing approach).

The proposed solution also simplifies the situation in the system operator's network. There are not so many power flow fluctuations, nor peaks, and the peaks are not so high. It is in the producer's best interest to coordinate its consumption with its production within its internal network. Consequently, DSO does not have to oversize the network that will not be used in normal operation. The producer is stimulated to request network capacity only for the maximum power that it really intends to use permanently. This provides real technical requirements on the network: requested power corresponds to the expected load (in both directions) in normal operation.

**Benefits for eligible producer -** EPC gets: a choice in creating its optimal NU status; the possibility of exercising the incentive tariffs for energy consumed on the production site; simplified connection reduces the primary investments and shorter construction time speeds up the return of investment through exploitation; capacity of network isn't a limiting factor for the connection of eligible producers - if the capacity of existing network isn't sufficient, the producer has the option to provide consumption on site; possibility of funding the network connection in stages; reduction of technical losses in normal operation.

**Benefits for DSO:** possibility of optimal network construction and operation: requested power corresponds to normal operation requirements; reduced fluctuations in daily and seasonal load diagram; reduced pressure for accepting all produced energy from RES into the network; reduced technical losses in the network operation; status of eligibility is regulated at PEM between HROTE and the producer - it isn't DSO's problem; simplified ownership situation (NEM is owned by DSO, PEM by producer); having only one PCC prevents EPC to sell purchased electricity as produced.

Although EPC has many options, due to the comparative advantages of DSO's network, DSO becomes a solution chosen by EPC, because EPC appreciates the network and relies on it as a guarantee of regular supply and operation.

**Benefits for Croatian economy:** increased profitability of investments in RES because of reduced primary costs and losses in normal operation; stimulated consumption at the production site encourages economic development and new job creation especially in economically underdeveloped areas because of RES characteristics (locations of RES plants are mostly outside urban centers).

**Benefits for the Croatia:** increased share of electricity produced from RES in total electricity generated (due to a more favorable method of calculation of energy produced and more profitable investments in RES); thus, an improved delivery of the RES promoting strategy in Croatia [6].

## ACCEPTABILITY OF PROPOSED APPROACH

The proposed solution is applicable to energy producers based on: constant RES (geothermal energy), predictable RES (biogas, biomass or solar energy), cogeneration, and ability to coordinate its consumption with its production (as air-conditioning/cooling systems and solar power plants).

The proposed approach is acceptable only if it brings an improvement (in relation to existing legislation) for all involved parties. Analyzed impact on the eligible producer, DSO, the Croatian economy and the State showed benefits for all. Only DSO loses income for not supplying the part of consumer's consumption that is supplied internally by the producer, instead by DSO. Compared to all presented benefits, DSO's losses are acceptable.

## CONCLUSION

The implementation of the first package of incentive regulations indicated some problems due to shortcomings and ambiguities of regulations, especially in marginal, special cases, primarily because the existing regulations [1], [2] haven't been adjusted to RES at the time of adopting incentive regulations.

The article proposes the solution for the EPC problem, elaborates the idea, technical solution and network connection schemes. The article presents the impact of a proposed solution on EPC, DSO, national economy and the state, and shows benefits and consequently acceptability of the proposed approach.

The article intends to give contribution to creating new legal possibilities for implementation of proposed additional option for EPC. Considering the soon adoption of new regulations in Croatia regarding harmonization with the third package of EU directives, the intent is to concurrently improve the incentive regulation. The goal is to regulate the possible application of proposed solution and harmonize incentive regulations with the other energy regulations in order to achieve an optimal solution for all interested parties, in accordance with the strategy of promoting RES.

## REFERENCES

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