Averting a Tragedy of Solar Commons: when free may not be the best

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This submission on the Australian Energy Market Commission's (AEMC) consultation paper *Distributed Energy Resources (DER) – Updating Regulatory Arrangements* aims to provide an economist's view on a contentious issue of export pricing for the use of distribution networks.

We argue that the current regulatory arrangements, where distributors cannot levy network charges on generators connected to the distribution network, may be sub-optimal both from the perspective of the exporter, and from the social welfare viewpoint. Price signals could help avert the Tragedy of Commons that otherwise would emerge in the common pool resource of hosting capacity managed under an open access regime.

Addressing the missing markets problem and placing a price on the use of network for exports, would create incentives for distributors to provide services that customers value. It would also open opportunities for new markets and services to emerge.

This transformation would be supported by increased local participation and community engagement guiding network investment decisions and building trust in the new electricity commons (including community battery schemes and peer to peer trading).

Regulation needs to evolve with rapidly changing industry

Electricity system is undergoing transformation from centralised to decentralised. This transformation requires new forms of regulation and governance. The system is no longer a one-way flow from large scale generators connected to the transmission network, transported over distribution network to end customers. Smaller scale generators now connect to all segments of the distribution network, including the micro-generation at the household level. Green energy has been supported by various government policies as the way to accelerate de-carbonisation of the energy supply. Households and small businesses are increasingly viewing themselves not just as consumers, but also producers of energy – both for own consumption and for sale (either to their retailer or via innovative market players such as virtual power plants).

While the demand from customers to use the distribution network to convey their small-scale, 'locally harvested' electrons to the market grows, there are no direct incentives for the networks to accommodate this demand, nor the mechanisms to recover the associated costs. Thus, the ability of networks to accommodate solar export and other DER (referred to as 'the hosting capacity') becomes the bottleneck in further integration of DER into distribution networks.

There are no obligations nor incentives for distributors to accommodate DER under the current regulatory regime. Network hosting capacity is funded only coincidentally, with the current regulation allowing network investment to support primarily consumption. Interests of exporters and other consumers do not always align. Not all consumers are exporters or have access to other DER (eg, apartment dwellers and renters). There are also differences within the exporters, with some of them using DER mostly for self-consumption and other mostly to benefit from supplying energy to the market.

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Exporters require distributors to provide hosting capacity for their exports. Under the current rules, there are no incentives for distributors to invest in hosting capacity unless it helps consumption. The opportunity cost of hosting capacity is perceived as zero by the exporters (the resource is free). Access to some base level of hosting capacity for micro generation is provided under the standard connection agreement, but the distributor cannot guarantee the performance of the service. Exporters compete with each other for the available hosting capacity. This universal access (non-excludability) and competing (rivalrous) use makes hosting capacity a common pool resource (CPR) managed under the open access regime. CPR under this form of governance gives rise to the Tragedy of the Commons, described below.

Common pool resource and Tragedy of the Commons

Hardin (1968) coined the term "The Tragedy of the Commons" that has become a catchphrase for the problems associated with the use of the common resource. Hardin's classic example referred to a pasture open to all that becomes overgrazed and ruined if all sheepherders act in their private interest. For the Tragedy of the Commons to occur, the resource can be either a public good or a common pool resource. Common pool resources are associated with potential overuse, crowding and potential depletion. This can happen in natural systems such as fisheries, forests or rivers, and also in man-made systems such as roads, ports and irrigation infrastructure (Ostrom, 1990:30; Künneke and Finger, 2009:3).

Common pool resource under open access management results in a market failure. Externalities and public good are two particular types of market failure.

Externalities occur when activities of one economic agent directly affect another. Private actions of individual decision makers and the market competitive solution in presence of externalities will result in an outcome that is not optimal from a societal viewpoint.

A public good is a commodity for which consumption by one individual does not preclude its use by others (a nondepletable commodity). As the opportunity cost of one using the public good is zero, there is an insufficient level of the good provided, with each consumer having incentive to enjoy benefits of the public good without providing it sufficiently herself (the free-rider problem) (Mas-Colell, Whinston and Green, 1995: 362-365).

When many agents both produce and are affected by the externality, multilateral externalities arise. They are further classified as depletable (or private or rivalrous), or nondepletable (or public or nonrivalrous). The externality can be depletable (if it 'wears out' with each application, behaving like a private commodity) or nondepletable (if its experience by someone does not preclude another from experiencing it at the same level, similar to a public good).

Most externalities regarded as serious social problems (eg water pollution, acid rain, congestion) take the form of nondepletable multilateral externalities.

There are substantial externalities associated with rivalrous consumption of common pool resource such as network hosting capacity. Consider the congestion of small-scale solar generation ('the exports') where voltage increase leads to the export curtailment up to the complete inability to supply and consume energy due to the inverter tripping.

Exports by one customer directly affect other customers on the same local network, as both are trying to access the same network. Voltage build-up caused by one exporter affects all other exporters on the same local feeder. Local export services are associated with multilateral externalities. These externalities are nondepletable as congestion experienced by one customer does not diminish the amount of congestion experienced by another. This is a classic case of the Tragedy of the Commons.

What policy options are available to address the Tragedy?

Generally, the answer depends on the type of externality driving the Tragedy of the Commons. Regulatory options include centralised (quotas, taxes) and decentralised solutions (such as creating tradeable property rights, bargaining, and making markets to price in the externality).

Decentralised market solution works well for multilateral depletable externalities as long as well-defined and enforceable property rights can be created. In contrast, market-based solutions are unlikely to work for nondepletable externalities that behave like a public good. With multilateral nondepletable externality, the government can use Pigouvian taxes or a partial market-based approach, such as a quota (cap-and-trade) system to achieve optimality. A cap on the total level of externality is specified, and the number of tradeable externality permits is distributed. The competitive equilibrium would result in the optimal allocation of externality.

From an economic standpoint, in order to correct the negative externality and prevent the Tragedy of the Commons in network hosting capacity, three potential measures could be applied: introducing a Pigouvian tax, establishing network access rights (property rights), or fostering of decentralised bargaining over the extent of the externality.

Quotas mandate the socially desirable level of the activity. Pigouvian taxation restores optimality by imposing a tax on the externality-generating activity. This allows for an agent to internalise the externality, by including the impact on others in her own decision-making problem.

Information requirements for the government to set either a tax or quota are high. There is a less intrusive form of intervention that enables the parties to reach an optimal agreement on the level of externality, by bargaining. This can be achieved if enforceable property rights are established with regard to the externality-generating activity. If trade of the externality can occur, then bargaining will lead to an efficient outcome no matter how property rights are initially allocated (the Coase theorem). Consumers need to know each other's preferences for bargaining to result in an optimal outcome.

A connection was made between the externality and missing markets (Meade, 1952; Arrow, 1969; Mas-Colell, Whinston and Green, 1995: 362-365). With well-defined and enforceable property rights and a competitive market for the right to engage in an externality-generating activity, optimality results as a market solution. Once a market exists for the externality, each consumer decides for herself how much of the externality to consume at the going prices.

Pricing can help solve the problem

One of the manifestations of the Tragedy of the Commons for road use is congestion. Transport economics model of congestion focused on the use of road space as a valuable and scarce resource which should be rationed by price. Price signals such as tolls are seen as essential to the efficient utilisation of existing road infrastructure and to the future investment planning (Vickrey, 1969).

Road users should pay for the marginal cost of using the road network if they are to be induced to make the right decision about the choice of the mode of transport, the timing and the route of the journey (Newbery, 1990). Road charges are designed to account for marginal social costs of the private decision, allowing it to internalise the externality of the road use.

Arnott, de Palma and Lindsey (1993) highlight the benefits from employing technologically sophisticated pricing schemes for urban roads that can smooth the peak demand and argue for the extension of the pricing principles to other congestion facilities such as public utilities, airports, telecommunications, and recreational facilities.

Users with different values of travelling at certain times will respond differently to the congestion price signal. Time of use pricing that includes an efficient congestion charge for road use is similar in its nature and purpose to cost reflective time of use and demand tariffs for distribution services. Without cost reflective road pricing, road improvements may yield low or even negative returns, leading to increased traffic volume and higher average costs.

St Vincent de Paul (SVDP) and SA Power Networks (SAPN) propose to remove clause 6.1.4 of the National Electricity Rules that prohibits distribution use of system charges for exporters. This rule change proposal, if successful, would enable the congestion pricing of network hosting capacity. Introduction of a cost-reflective price for exports can:

- internalise the externality and place value on the use of the resource
- incentivise distributor to invest in the resource that now generates value
- enable optimal use of the existing resource (using TOU or demand pricing)
- open new markets and services (leading to dynamic efficiency).

The industry has been guided by these principles in its journey towards cost reflective network tariffs for consumption. We consider that extending these principles to introduce network charges for exports would help avert the tragedy of the solar commons. From an economic standpoint, SVDP's and SAPN's proposal to remove clause 6.1.4 of the NER is in the long-term interests of consumers and should be supported.

Total Environment Centre (TEC) and Australian Council on Social Services (ACOSS)'s proposal attempts to establish some form of property rights over the network hosting capacity. These property rights do not appear to be clearly defined. With its opt-in basis for an enhanced level of access, TEC/ACOSS's proposal is unlikely to achieve the same level of DER integration as that supported by export pricing and is unlikely to result in a socially optimal outcome.

Governance will evolve along with the regulations

Hardin's classic pasture allegory was criticised as conflating the idea of a scarce resource (a pasture) with the governance of the resource (open access), and further conflating open access with commons as the form of governance (Frischmann, Marciano and Ramello, 2019: 221).

Commons is the form of governance by the relevant community over the common pool resource. Open access differs from commons in terms of ownership (none vs communal), definition of community (public vs a defined group) and degree of exclusion (none vs exclusion of non-members) (Frischmann, Marciano and Ramello, 2019:221).

As technology changes, industry structure and institutions co-evolve. As system transitions from integrated to decentralised, industry oversight and regulation transition from government to governance. General monopoly regulation is superseded by sector specific regulation (access competition) and then by network competition (Künneke and Finger, 2009:15).

With the growth of distributed resources, new forms of governance are likely to emerge involving the public, the private and the third sector (civil society). Self-governance or governance by network might be the best suited to manage decentralised common pool resources. A combination of self-governance, government ordering and markets would govern infrastructures that are distributed and systemic beyond the national level (Ostrom, 1990).

The new self-governance model relies on reciprocity, reputation and trust (Ostrom, 1998:9, Swaney 198:625). Local communities already contribute to development of last-mile networks where there are

no official providers or low economic returns. Knowledge commons and other shared self-governing resources proliferate. “Infrastructure commons point to a new and interesting way to manage common pool resource problem in large socio-technical systems, where civil society self-governance can play a much more active role” (Künneke and Finger, 2009:17).

“Social demand for trusted governance of shared … resources… is growing, even as trust in governments and markets as sources of governance seems tenuous” (Frischmann, Marciano and Ramello, 2019:225)

While regulatory change to enable pricing of exports would address the market failure and lead to the more efficient outcomes, its success ultimately depends on the active engagement and acceptance by communities. New community energy use schemes such as community batteries and peer to peer trading, supported by two-way tariff structures capable of rewarding customers for the behaviour that helps avoid future costs, could turn a potential Tragedy of the Commons into an opportunity to empower local commons in shaping the distribution networks of the future.

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