Distributed generation spiral of growth

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Content

Introduction

Traditional supply chain

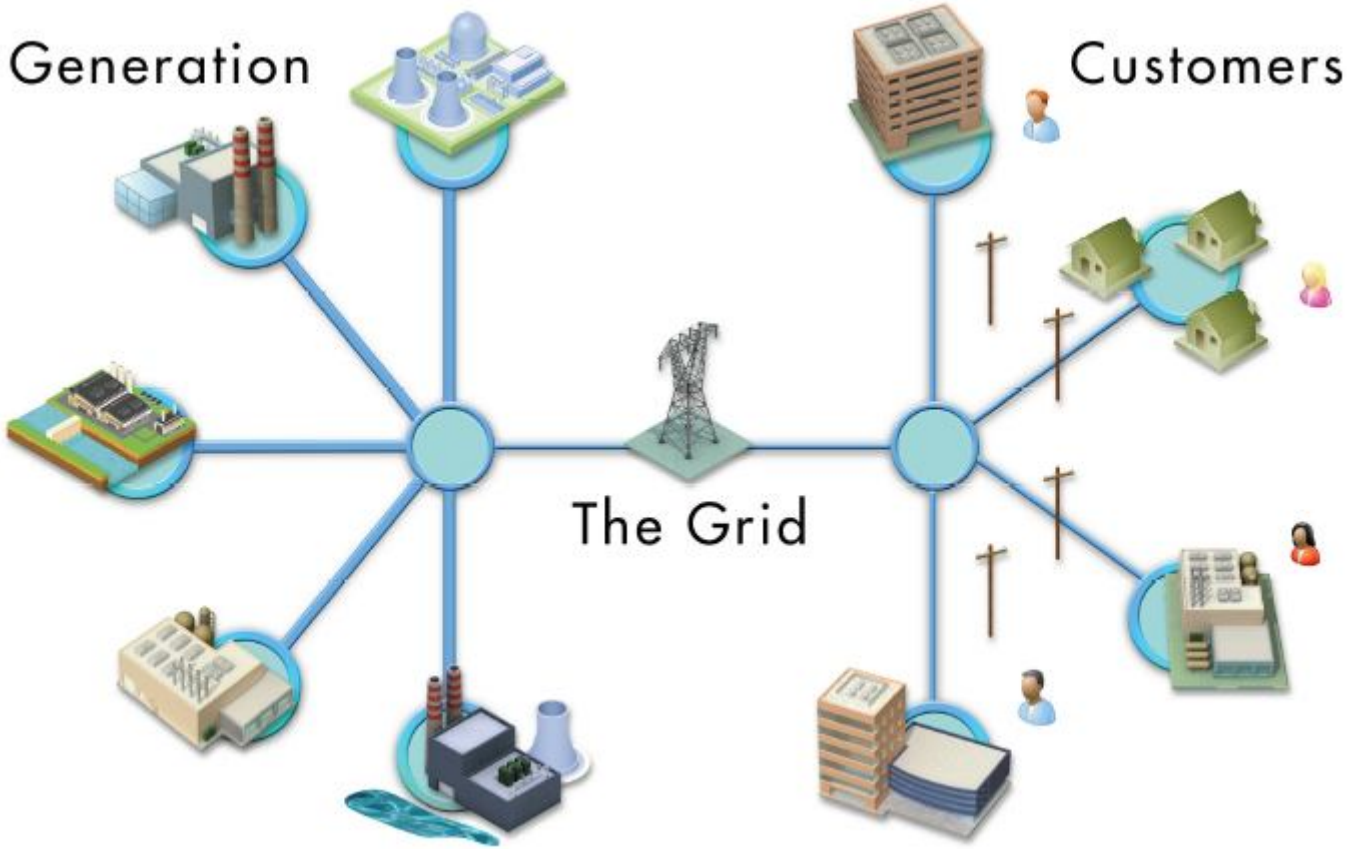


Figure 1. Today's Power System Characterized by Central Generation of Electricity, Transmission, and Distribution to End-Use Consumers [1]

Introduction

Wind of change

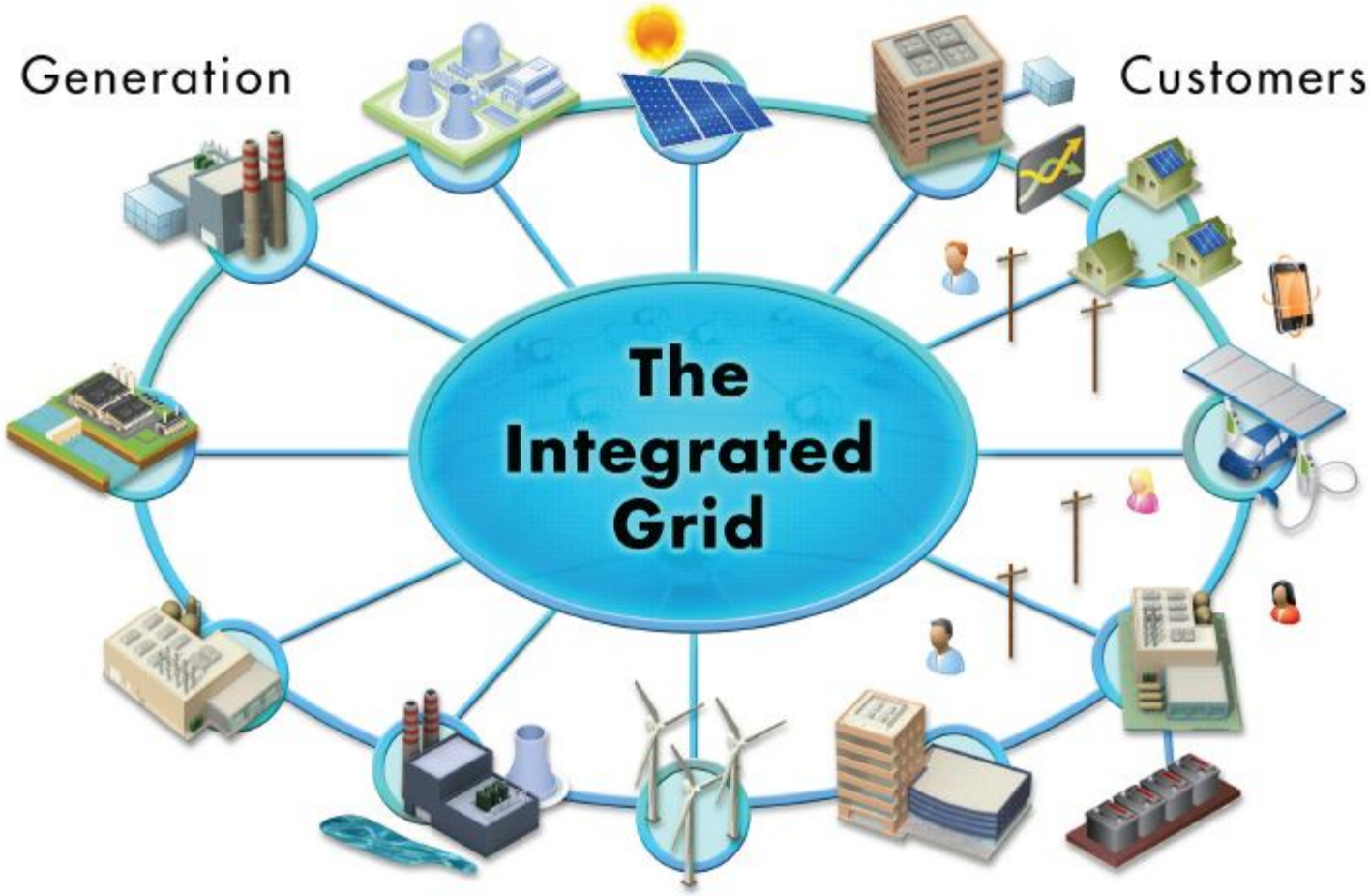


Figure 2. Creating an Architecture with Multi-Level Controller [1]

Energy trend

Renewable impacts on utilities

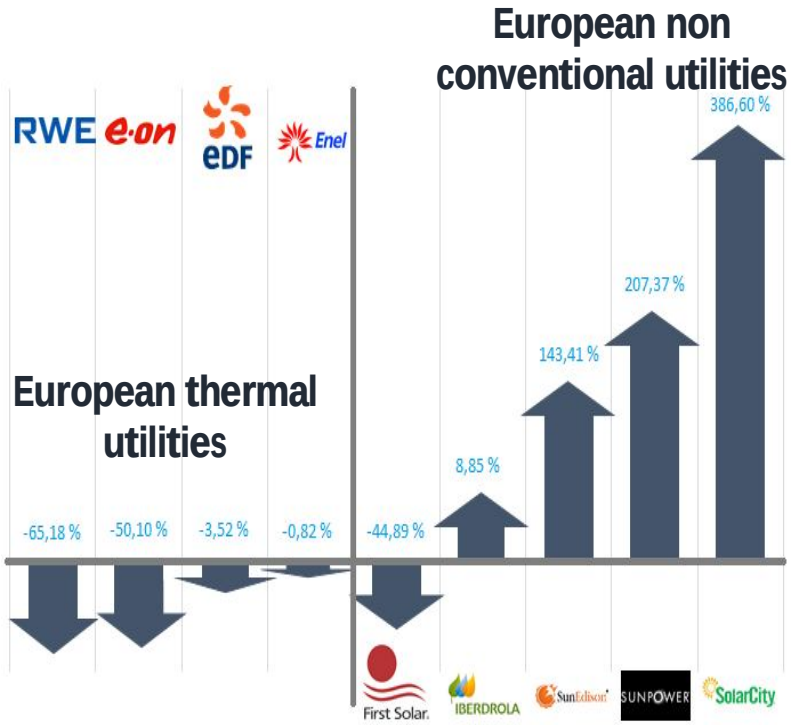


Fig 1. Share price in the last 5 years (Bloomberg, 2015)

A utility as EON is changing its energy strategy!!

- 13 GW of thermal generation
- Renewable energies
- Distributed generation
- Customer support solutions

Energy trend

Development of Distributed Energy Resources (DERs)

Distributed Energy Resources (DERs): energy supplied to medium voltage (MV) or low voltage (LV) distribution systems (Akorede et al., 2010).

Distributed Energy Resources (DER) include (Ruester et al, 2014):

- **Distributed generation**
- **Local storage**
- **Electric vehicles**
- **Demand response**

Energy trend

Here comes the sun...

- Solar PV cost has reached **grid parity** in many locations (Irena, 2015; Bayod-Rújula, 2009).
- Solar PV is growing fast: between 2000 to 2014 the annual growth was 44% (Fraunhofer, 2015).
- There is an energy trend from centralized to decentralized system of power generation, which poses technical challenges (EPRI, 2014).

Rethinking traditional UBM

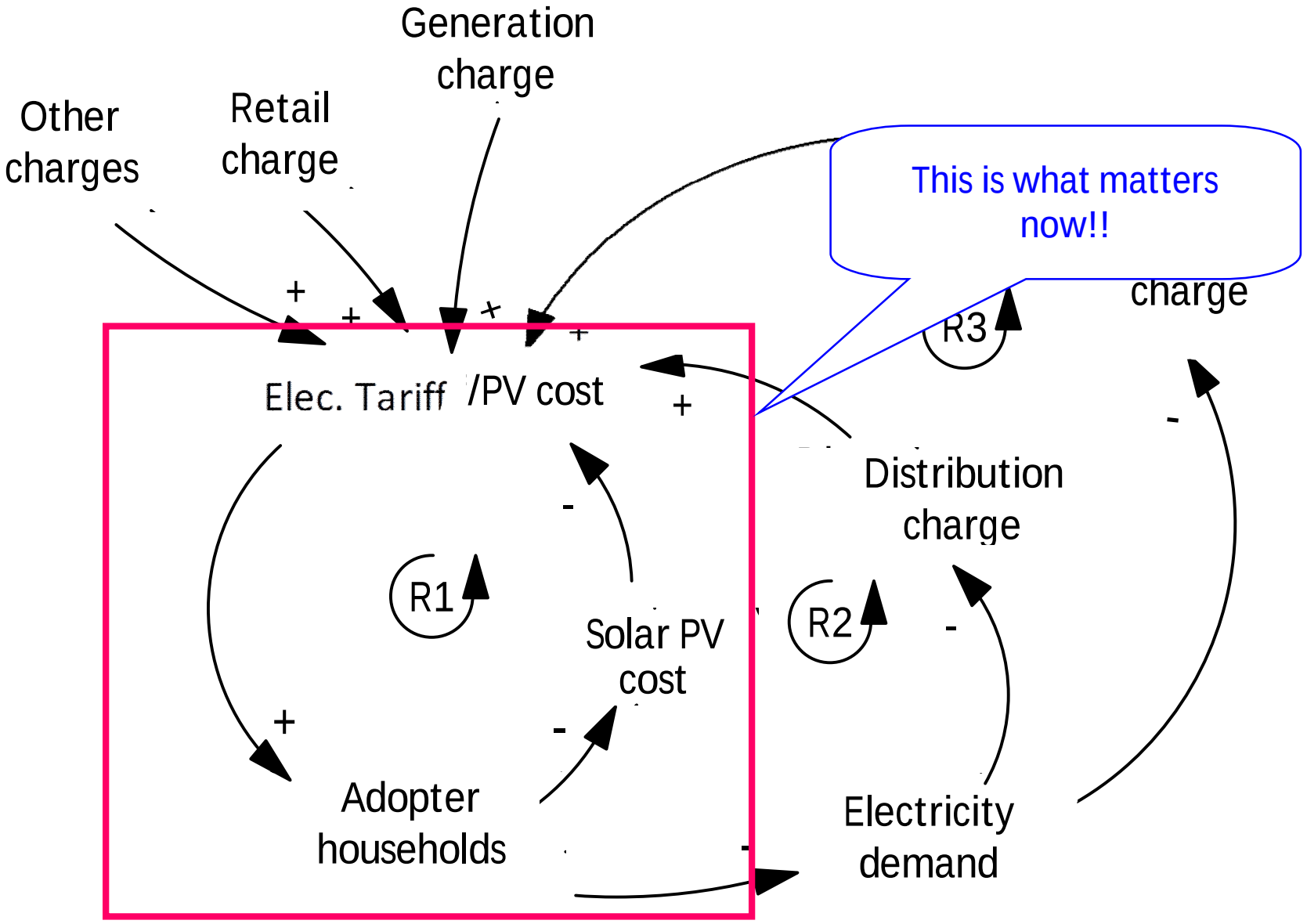
The future is not what it used to be...

New market players....

- *If the new technologies are truly disruptive, utilities should take an aggressive attitude. A purely defensive posture of protecting the current business model and profits may temporarily avert short-term financial distress but not long-term challenges [4]*
- *An organizations is ambidextrous if it is capable of both exploit their existing capabilities and develop new competencies that are required in the long-term [14].*

Source: [15]

Distributed generation spiral of growth



Types of new business models

There are plenty of opportunities

I. Distributed Power Generation business models

1.Supply of Distributed Generation Systems

2.Leasing

3.PPA

4.Rent the space model

II. Demand management business models

1.ESCOS

2.Supply of smart home solutions

3.Demand response

III. Regional aggregation business models

1.Community solar

2.Microgrid

3.Virtual power plant

[16],[17],[18],[19]

Case Studies

- Brazil
- Colombia

Both countries have lots in common. For instance: high hydroelectricity, high solar irradiance and high electricity price volatility.

We already know that in Colombia....

What are the market conditions that may lead to the utility death spiral?

- PV grid parity, net metering, volumetric charge and oversized PV systems
- Free-riders

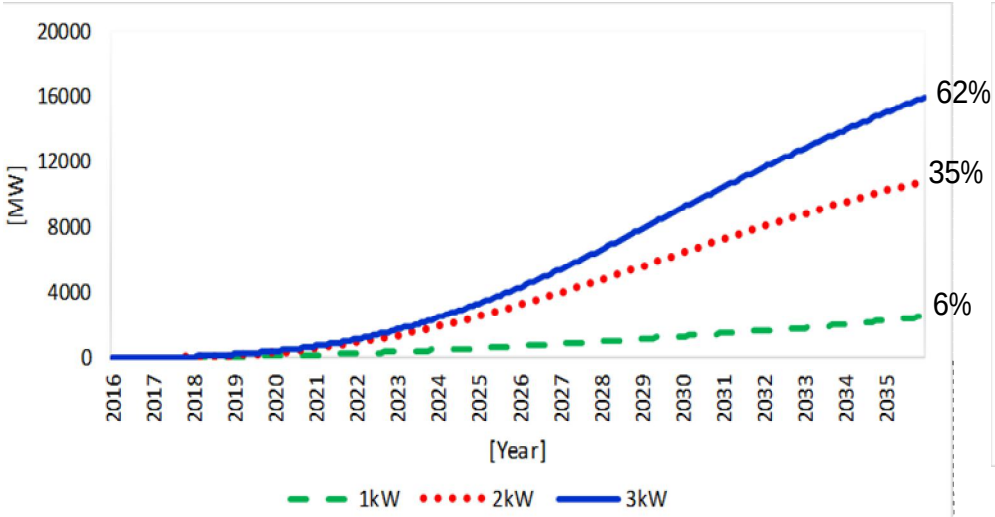


Figure 1. Solar PV cumulative installed capacity (Percent of cumulative installed capacity).

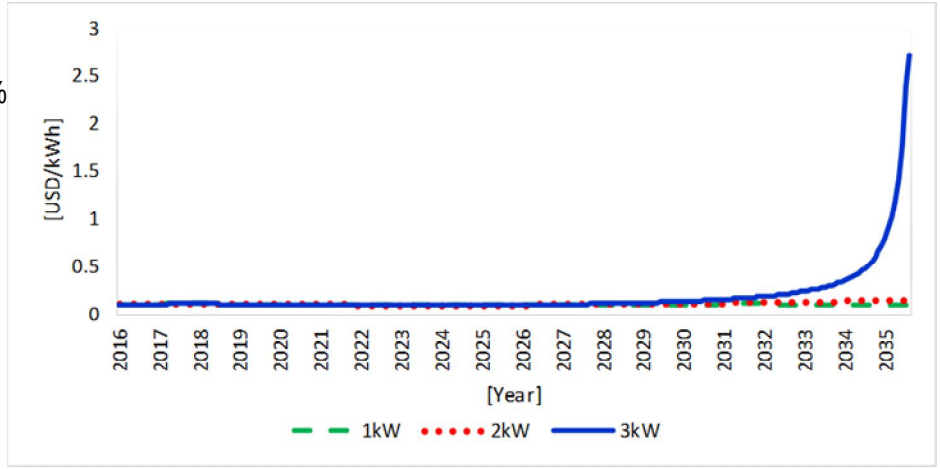


Figure 2. Final tariff for residential sector

The system collapses in 2035, since the total solar PV production minus the total energy consumption falls dramatically in the residential sector for hypothetical case.

What are the long-term effects on customers and utilities?

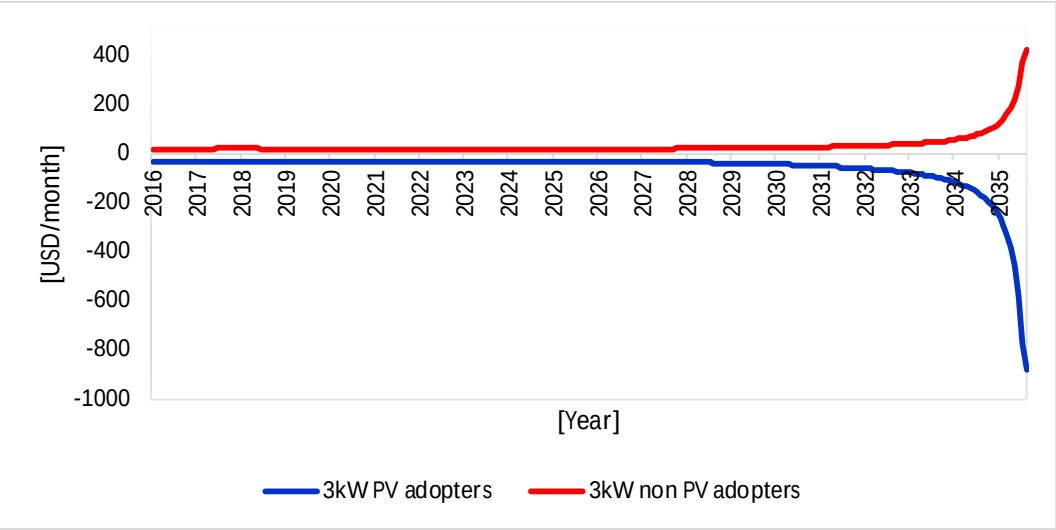
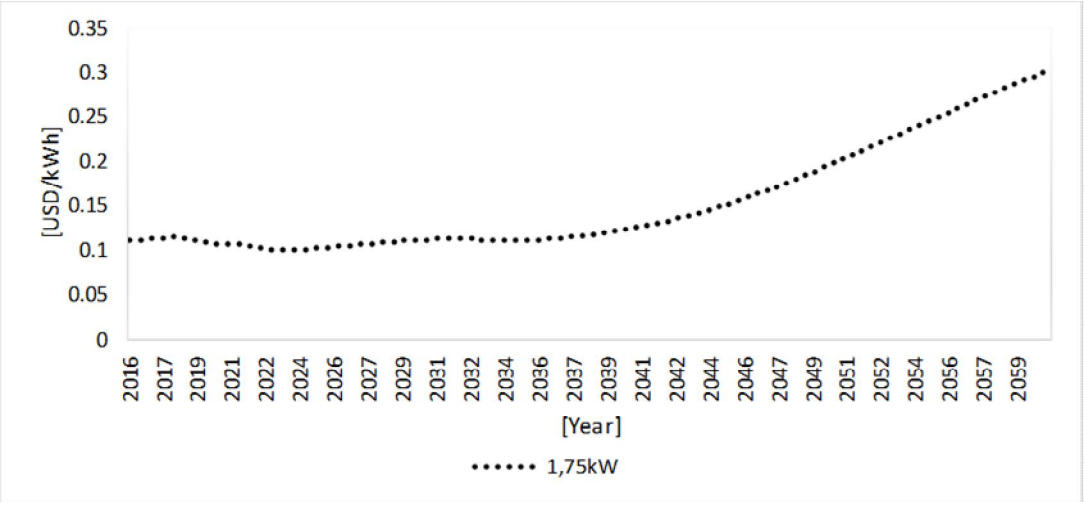


Figure 3. Energy bill for customers under oversized PV systems (3kW)

Revenue losses of utilities coincide with the high expenses of non-PV adopters and high revenues of PV adopters

Figure 4. Residential tariff for 1.7kW PV panel size and a longer timeframe



Can the regulator and utilities avert a death spiral achieving social welfare?

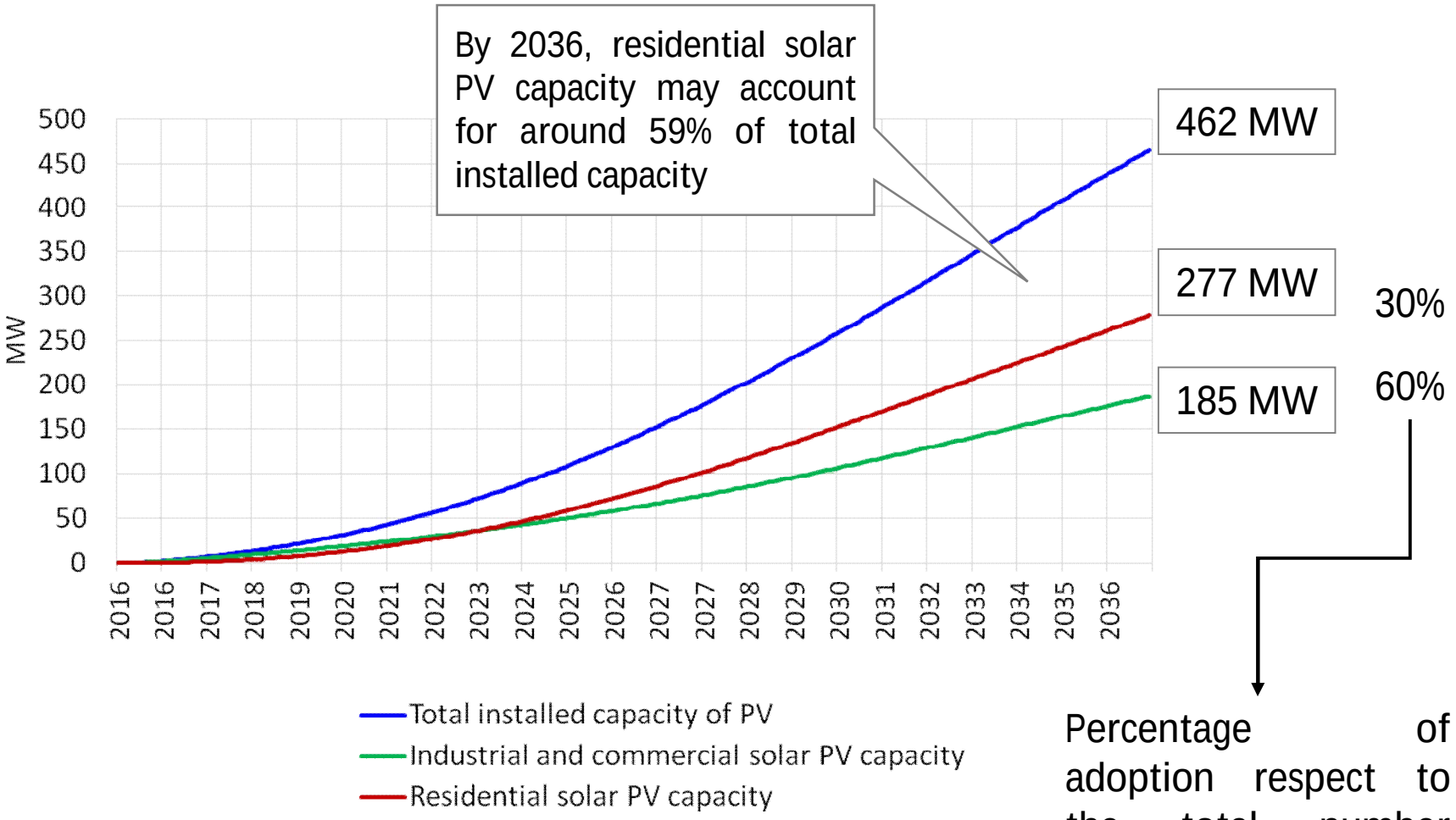
Some alternative actions could be adopted…

1. **Implementing a back-up fee**
2. **Shifting from Net Metering to Net Billing**
3. **Changing tariff design**
4. **Rethinking business models**

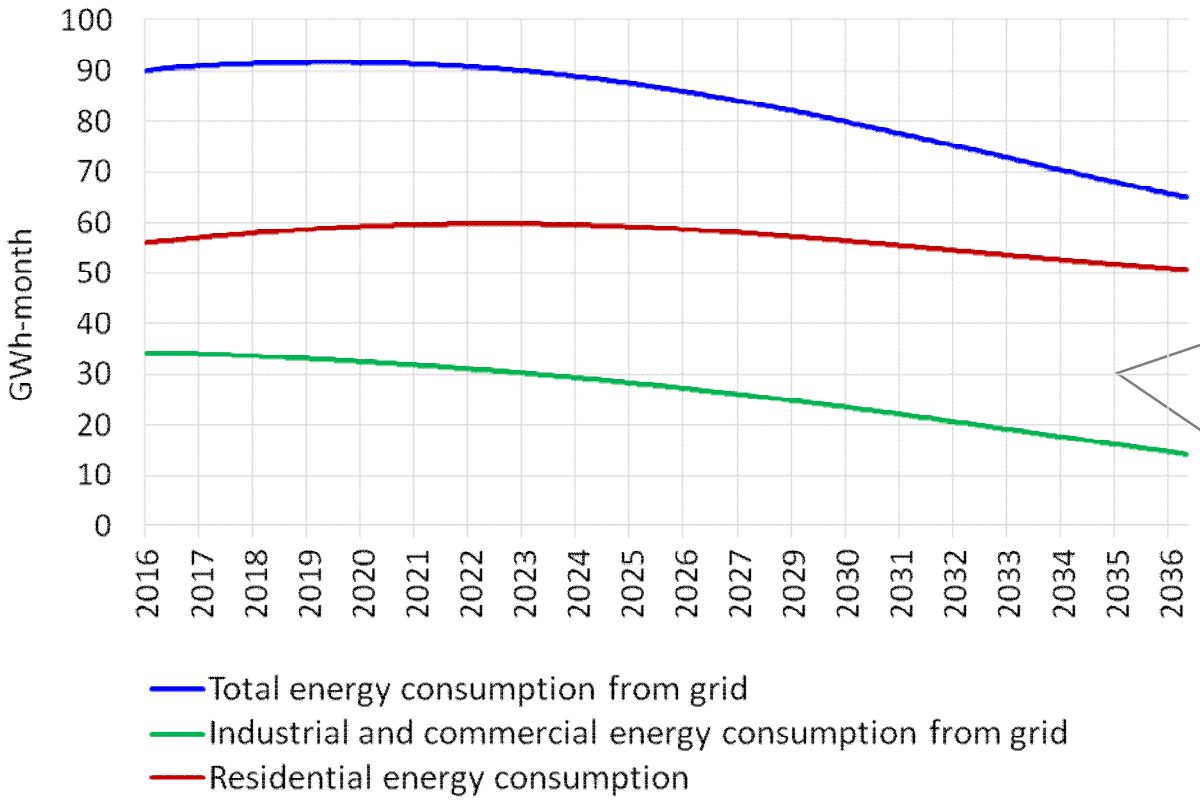
Some of these actions may only delay slightly solar PV attractiveness and its adoption.

We already know that in Brazil (Minais Gerais)....

What is the evolution of cumulative PV installed capacity?

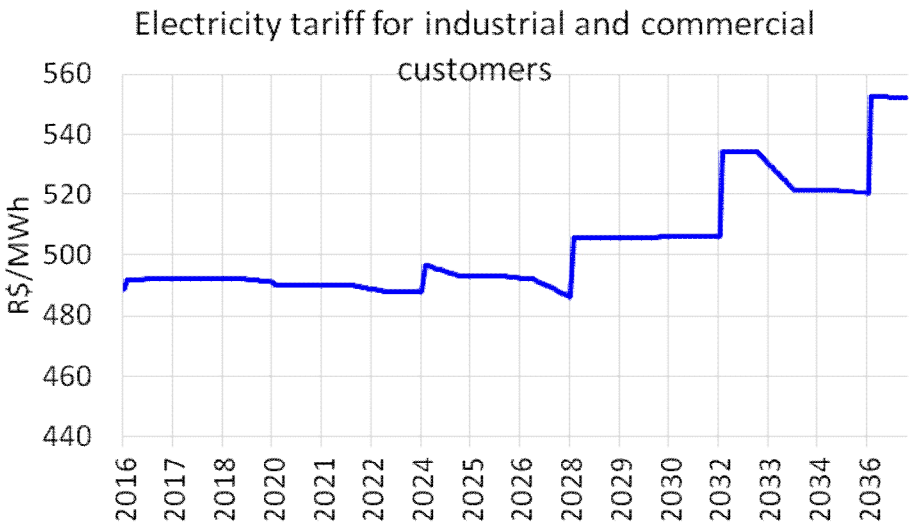


What are the effects of PV development on energy consumption?



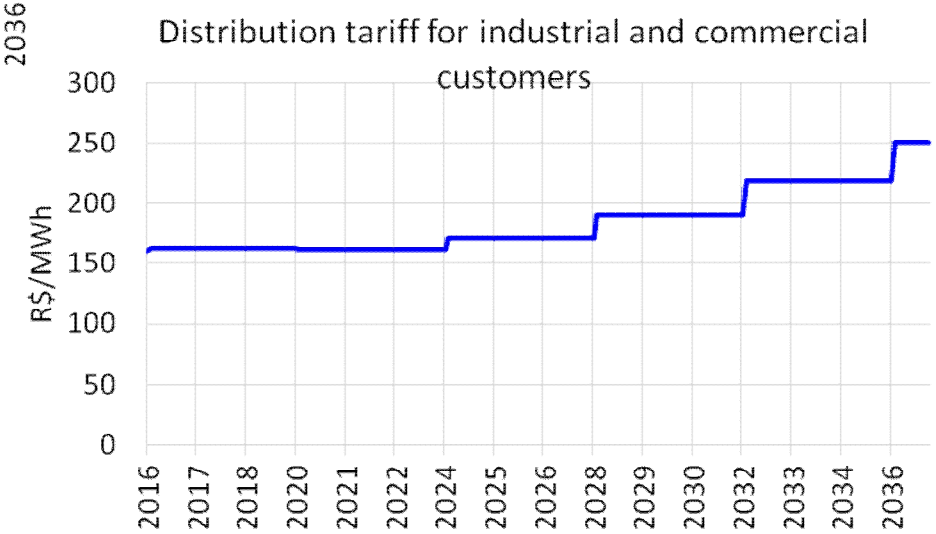
From 2016 to 2036, residential energy consumption may decrease at rate of about **0.5%** per year, while industrial and commercial energy consumption declines at a rate of about **4%** per year

What are the effects of PV development on tariffs?

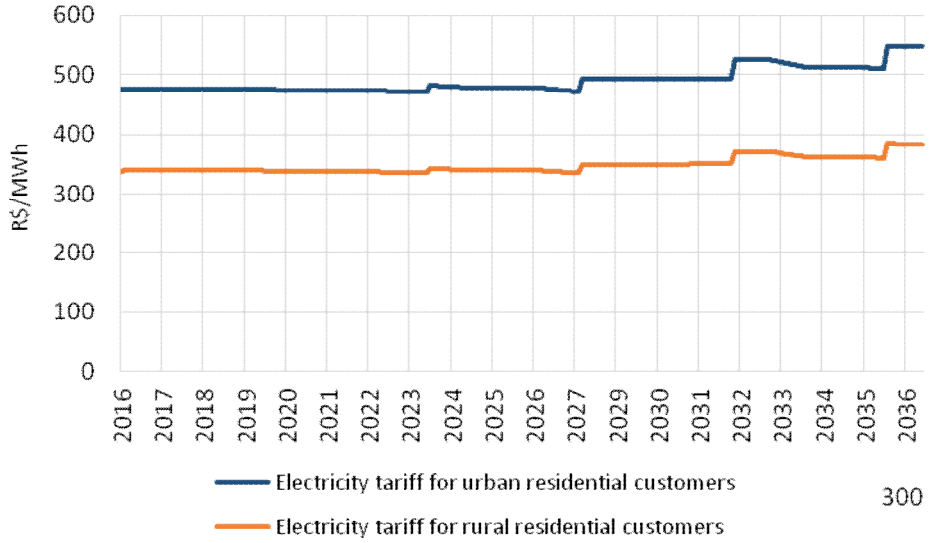


From 2016 to 2036, electricity tariff for industrial and commercial customers may grow by about **13%**

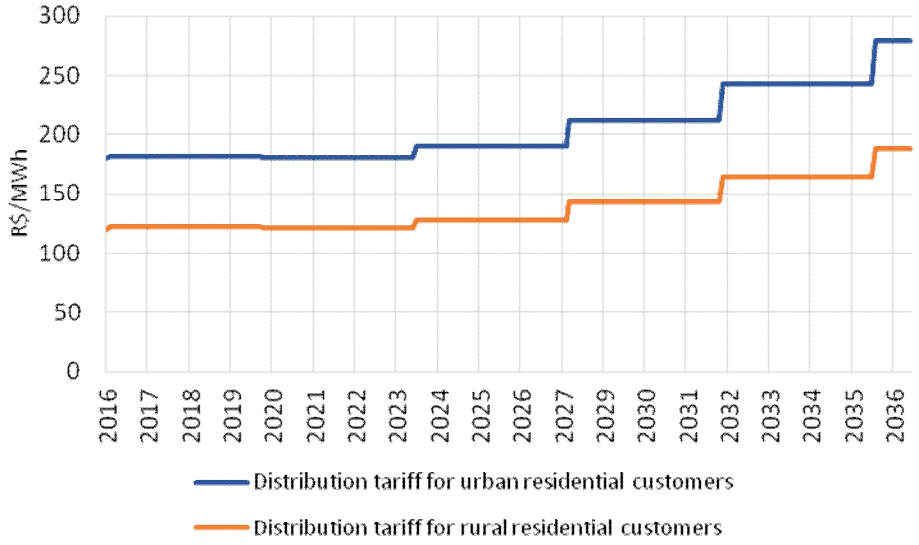
Between 2016 to 2036, distribution tariff for industrial and commercial customers may grow by about **56%**



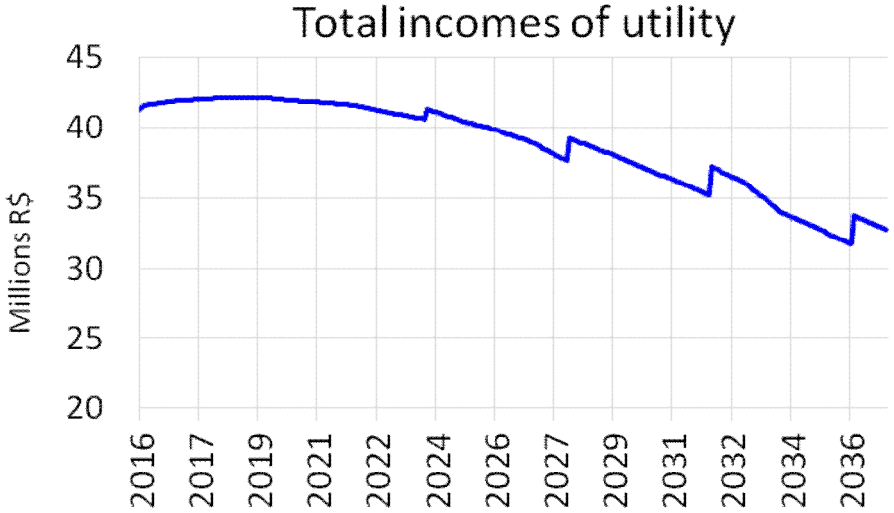
What are the effects of PV development on tariffs?



Similar behaviour, energy cost remains almost constant. Between 2016 to 2036, distribution tariff for residential customers may rise by about **55%**

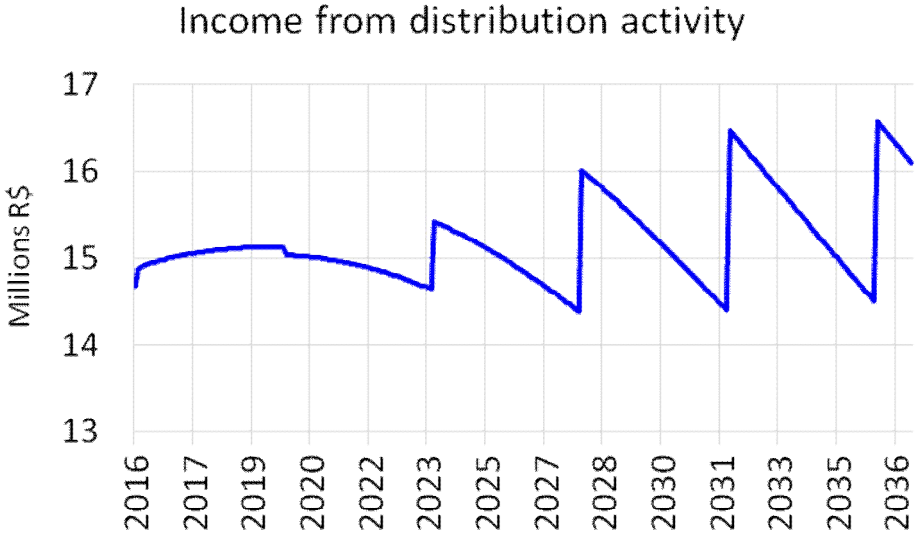


What are the effects of PV development on utility incomes?



Slightly downward trend due to energy cost reduction

Growing trend of income from distribution activity due to tariff revision each 4 years, losses of income due to PV penetration



We would like to know...

- How utilities may adapt their business strategies to become competitive in a decentralized power market?
- Alternative solar business models and strategies that may be *appropriate* in the future?
- How alternative business models may create value to society?

Conclusions

- Solar PV adoption leads to lower energy prices
- The short-term view to the utility death spiral: Implementing a back-up fee, Shifting from Net Metering to Net Billing and, in general, different tariff designs. All these may only slightly delay PV adoption.
- The diffusion of PVs offers opportunities for successful business models and strategies.