

# PV Revamping/Repowering and New Build Technical Rules and Best Practice

Napoli - April 5th 2018





### M&P at a glance ABOUT US





**Moroni & Partners** is a consultant engineering company specialized in the renewable energy market, headquarters in Ancona, established in 2007 by Mauro Moroni, PhD in Energetics at Politecnico delle Marche.

We provide engineering services consultancy to Investors, Banks, Lenders, Industrial customers and EPC Contractors in the field of Renewable Energies.

#### A few numbers about us:

- More than 50 professionals
- 90% of staff graduated in Engineering
- More than 4 GW of experience in Renewable Energies

#### Awards:





finesting

Membership:





CEI Comitato Elettrotecnico Italiano







Finest Asset Management Services - Italy wealth:finance2016

### M&P at a glance OUR DIVISIONS



### Engineering Environmental impact assessment and authorisations Design, engineering, urban and structural planning Detailed Engineering Works Management

- •Health & Safety
- •Energy Efficiency for Industrial & Real Estate applications
- •Re-Engineering

#### **Technical Advisory**

- Preliminary evaluation and business plan
- Technical and
- Administrative Due Diligence
- Testing during and after construction
- Instrumental verifications
- Insurance appraisal
- Final & Provisional
- Acceptance Tests (FAC/PAC)

#### **Asset Management**

- •Service supply management
- Validation of Maintenance activities
- •Remote monitoring of key performance parameters
- •Assistance for administrative and accounting requirements
- •Assistance in the relationship with Tax Authority (UTF) and GSE
- •O&M supervision





#### M&P at a glance COMPANIES THAT HAVE CHOSEN US











# REVAMPING AND REPOWERING





### GSE rules INTERVENTIONS ALLOWED BY GSE









## Modules Replacement ISSUES RELATED TO PV MODULES



### PV modules are often affected by **different failures** according to their life period









## Modules Replacement ISSUES RELATED TO PV MODULES





EVA yellowing on cracked cells



Shunt damage on backsheet



Backsheet air side yellowing



Glass antireflective coating delamination



Backsheet delamination



Backsheet deep cracking





## Modules Replacement THE PARTNERSHIP WITH DUPONT





#### **TARGETS:**

- Define an **on-site procedure** (site visit and instrumental tests) to be performed in order to **detect and analyze the issues** on the plants, with particular **focus on panels and back-sheet;**
- Risk assessment for the most **common degradation impacting photovoltaic modules**, e.g. back-sheet;
- Mitigance proposal;
- **Development of technical best practices** reducing risk of premature system degradation, e.g. appropriate BoM selection and O&M protocols;
- Assistance to the Operators in **developing reliable and durable PV** systems for the most competitive LCOE.



Backsheet defects = 7.5%





### Modules Replacement THE BENEFITS OF THE NEW MODULES







### \* 小油 =











#### GSE rules for PV Revamping INVERTER REPLACEMENT BENEFITS















MAAWARDS2016

### GSE rules for PV Revamping CONFIGURATION VARIATIONS – PID RECOVERY













# REVAMPING INTERVENTION BUSINESS CASES





#### Business Cases SERVICES PERFORMED BY M&P









## Business Cases INSTRUMENTAL TESTS











### Business Cases REVERSE ENGINEERING









## Business Cases FOCUS ON PERMITTING



Irregular historical framework for ground mounted PV (AU, DIA, PdC, PAS...) Preliminary Q&A with local authorities to detect the <u>proper</u> <u>procedure</u> for the substantial/not substantial modification of:

Rated Power

**Plant Layout** 

In many cases the As-Built Status is not compliant with the authorized A permitting compliance check is suggested before the beginning of the procedure. ("Accertamento di conformità" procedure if necessary)

Revamping/Repowering permitting suitable procedures ⇒∠\_\_\_

Modification of the current AU

PAS - Procedura Abilitativa Semplificata

Screening VIA in case P>1 MWp (Repowering)







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AS BUILT – TECHNICAL FEATURES		
PV Modules number (GSE)	4.278	
PV Modules Power [Wp]	230	
GSE Plant Rated Power [kWp]	983,94	
Power up to 1% DTR Limit [kWp]	993,78	
Module Rated Efficiency	14%	
Modules per string	23	
Strings number	186	
Inverter	3	
GSE FIT (2°Conto Energia) [€/kWh]	0,314	
Grid Connection	2011	
FIT Period End	2031	



















#### DEFECTIVE DETECTED MODULES AND STRINGS OVER PV PLANT LAYOUT















MA AWAFDS 2016 Energy Fare of the Tour - Tally Tallow results ESTIM







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### Business Cases MODULES REPLACEMENT - REPOWERING





#### Business Cases MODULES REPLACEMENT - REPOWERING



The additional portion of the system must be equipped with its own **dedicated meter** (and inverter...)

The intervention must be **duly authorized** in accordance with the urban planning regulations in force.

Request for **upgrade of the connection** for additional power, according to **TICA**.

Registration in **Gaudì** of the plant upgrade as a new section or creation of new production unit related to the new section inserted (different commercial contracts).

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SCENARIO	1	2	3
CAPEX	€ 307.086	€ 447.184	€ 553.226
IRR	8,23%	9,30%	8,76%
NPV	€ 133.302	€ 240.938	€ 291.808
Payback Time	9 years	9 years	9 years













## Business Cases PROCEDURE RECAP









### Business Cases INVERTER REPLACEMENT



#### INVERTER REPLACEMENT EVALUATION ACCORDING TO AVAILABILITY AND CONVERSION EFFICIENCY INCREASE.

Plant Rated Power: **852 kWp** Inverter type: **Central** Inverter AC Power: **100 kW** Inverter Number: **9**  CURRENT EURO EFFICIENCY: 96,2% VS DECLARED 96,4%

HISTORICAL INVERTER AVAILABILITY: 96,8%

CURRENT ENERGY YIELD: 1.729 kWh/kWp









## Business Cases INVERTER REPLACEMENT



Brand	Model	Max Efficiency	Euro Efficiency	Efficiency Increase
BRAND 1	MODEL 1 (ACTUAL)	97.0%	96,4%	-
BRAND 2	MODEL 2	98,0%	97,7%	1,35%
BRAND 2	MODEL 3	98,7%	98,2%	1,87%
BRAND 3	MODEL 4	98,6%	98,5%	2,18%
BRAND 4	MODEL 5	98,7%	98,5%	2,18%

#### INTERVENTION CAPEX 90-100.000 €/MW Including transportation, reconfiguration and installation

EURO EFFICIENCY: FROM 96,2% TO 97,5%

AVAILABILITY: FROM 96,8% TO 98,5%

#### ENERGY YIELD: FROM 1.729 to 1.769 kWh/kWp

+2,3%

INVESTMENT PROFITABILITY			
CAPEX	100.000 €/MW	95.000 €/MW	90.000 €/MW
IRR	13,9%	14,8%	15,8%
NPV	€ 94.382	€ 98.642	€ 102.902
PBT	6	6	5





**INVERTER** 

REVAMPING TARGETS





# UTILITY SCALE PV IN NEW BUILD MARKET





#### RES Italian Market SEN 2017 – SOLAR TARGETS





Source: 2017 Italy's National Energy Strategy (SEN="Strategia Energetica Nazionale"), document published on November 10th, 2017





### New Utility Scale PV SERVICES PERFORMED BY M&P









### New Utility Scale PV DEVELOPMENT KEY FACTORS









### Utility Scale PV ACHIEVABLE YIELD OPTIMIZATION











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