ID	Name	Responsible
1	**WP1** Project Management	**QMUL**
2	**Tasks**	
3	T1.1 Establish the formal structure of the project management groups and advisory committees	
4	T1.2 Conduct financial transactions.	
5	T1.3 Compile and monitor project deliverables and reports.	
6	T1.4 Compile and monitor calendar for project meetings.	
7	T1.5 Compile dissemination and outreach activities.	
8	T1.6 Brokerage on scientific, ethical, gender and administrative matters.	
9	**Deliverables**	
10	D1.1 Report describing consortium groups and responsibilities, specifics of gender action plan.	
11	D1.2 MANMADE web-page.	
12	D1.3 Network analysis of interactions between consortium members and MANMADE Forum.	
13	D1.4 Network analysis of interactions between consortium members and MANMADE Forum.	
14	D1.5 Network analysis of interactions between consortium members and MANMADE Forum.	

ID	Name	Responsible
15	D1.6 Workshop targeting careers in science for women, incorporating key themes of MANMADE Project. To be organized with local school authorities (Inner London area)	
16	**Milestones**	
17	M1.1 Constitution of Project Management groups as per Section 6 above (M0)	
18	M1.2 Set up of MANMADE web-site with data collation (M3)	
19	M1.3 Selection of a candidate School for implementation of D1.6 (M12)	
20	**WP2** Network Collation	**JRC**
21	**Tasks**	
22	T2.1 Initiate, expand and maintain continuous contact with organizations responsible for electricity high-voltage, energy and urban networks in order to obtain the most up-to-date topographical maps of grid systems.	
23	T2.2 In the event of the unavailability of grid interconnection tables directly from network utilities generate interconnection tables directly by digitizing maps and parsing the interconnection date as topological connection graphs.	
24	T2.3 Compile map of major gas trunk from North Sea and Russia and gross gas flow exchanges into W. Europe and transition countries. Assess for each country net dependence and reserves of gas supplied for electricity generation.	
25	T2.4 Liaise with electricity market authorities from Nord Pool electricity markets in order to obtain, directly, time series of spot market prices.	
26	T2.5 Generate topologies and graphs of urban transport systems of (Italian urban area)	
27	T2.6 Prepare and maintain a data base (wherever applicable also GIS-based) containing assembled data sets in format suitable to be used within the context of WP3 (Math methods) and thematic WPs 4 5 6 (electricity, financial, gas and transport interconnections	
28	**Deliverables**	

ID	Name	Responsible
29	D2.1 Data sets of major gas lines and exchange flows between and into Western Europe.	
30	D2.2 Data sets of spot price electricity traded in selected European electricity markets.	
31	D2.3 Sets of spatial and topological maps of selected urban/transport networks (Italy, or other).	
32	D2.4 Data sets containing the grid connections for the NORDEL /UCTE synchronously connected high-voltage electricity grid system.	
33	**Milestones**	
34	M2.1 Selection of two urban networks viable to conversion into topological connection maps (M6).	
35	M2.2 Agreement with the Nordic Countries Emergency Planning Association (NEF) and NESA for data sharing of electricity (+other) networks (M9)	
36	M2.3 Agreement with NORDPOOL for access to time histories of share prices (M9).	
37	**WP3** Mathematical Methods	**QMUL**
38	**Tasks**	
39	T3.1 Assessment of statistical analysis of methods of non-linear time series and applicability to selected network phenomena (European grid Black outs)	
40	T3.2 Assessment of graph-theoretic methods for a-periodic networks.	
41	T3.3 Review and development of network growth laws for irregular networks and comparison to real-world electricity and urban infrastructure networks.	
42	T3.4 Risk measures for extremely volatile markets will be developed and their robustness against estimation error analyzed.	

ID	Name	Responsible
43	T3.5 Development of vulnerability indicators for heterogeneous interconnected networks	
44	T3.6 Analysis of feedback mechanisms in networked systems. Develop phenomenological laws reminiscent of physically-driven networks.	
45	T3.7 Study on the effects on flow dynamics on the scale-fee networks.	
46	**Deliverables**	
47	D3.1 Report on the use of the Hurst coefficient and correlation with power law decay for the project data	
48	D3.2 Report on the applicability of growth mechanisms of evolving networks and growth strategies to guarantee desired topological features (e.g. scale free structure, degree correlation etc.).	
49	D3.3 Scientific paper on the vulnerability of heterogeneous interconnected networks.	
50	D3.4 Emergence simulator (neural network) in generic graphs to mimic long-range coupling in networks.	
51	**Milestones**	
52	**M3.1** Data sets and time-line as per WP2	
53	M3.1a Data sets of major gas lines and exchange flows between and into Western Europe.	
54	M3.1b Data sets of spot price electricity traded in selected European electricity markets.	
55	M3.1c Sets of spatial and topological maps of selected urban/transport networks (Italy, or other).	
56	M3.1d Data sets containing the grid connections for the NORDEL /UCTE synchronously connected high-voltage electricity grid system.	

ID	Name	Responsible
57	**WP4** Electricity Networks	**COLB**
58	**Tasks**	
59	T4.1 Based on girded meteorological, construct wind fields covering Europe with a temporal resolution of 6 hours.	
60	T4.2 Based on this wind field, estimate wind power generation on different spatial scales.	
61	T4.3 Quantify the statistical properties of this highly intermittent power generation dataset. Concentrating on the spatial scale where the amplitude of fluctuations is optimized with respect to thedemand of European electrical power line interconnections.	
62	T4.4 Topological analysis of EU synchronously connected electricity grids.	
63	T4.5 Modal analysis of selected of EU electricity grid sectors.	
64	T4.6 Network fragmentation studies of EU grid.	
65	**Deliverables**	
66	D4.1 Wind field construction assessment report and maps of potential wind energy production over Europe (M18).	
67	D4.2 Workshop on natural and man-made vulnerabilities of EU grid.(M35)	
68	D4.3 Topological analysis of selected EU synchronous grid systems and report on risk and fragmentation analysis of EU grid networks (M36).	
69	**Milestones**	
70	M4.1 Assessment and comparative analysis of wind field construction methodology (M12).	

ID	Name	Responsible
71	M4.2 Lower and upper bound estimates of energy production at different meteorological scenarios over Europe (M24).	
72	M4.3 Analysis of risk related to weather extremes on different network architectures (M24)	
73	M4.4 Data set of EU grid interconnection available (24).	
74	**WP5** Dynamics of supply-chain and market volitility of networks	**LIUC**
75	**Tasks**	
76	T5.1 Definition of the supply-chain logical model by means of the Petri nets formalism; development of the corresponding simulation model; identification and evaluation of the risky events concerning the supply chain. Development and implementation of model of	
77	T5.2 Temporal time series analysis: Simulated and experimental data sets from energy market spot prices and loadings in electricity power transmission systems will be analyzed using Cross Recurrence Quantification Analysis to find possible correlations between	
78	T5.3 Assessment of blackouts events: non-linear time series analysis of volatility in energy market spot prices will be used to correlate spot prices with blackouts. The analysis would be made both adapting typical financial models (GARCH models) to the energy	
79	T5.4 Early warning detection of blackouts using time series of loadings in power transmission systems: state-space divergence reconstruction approach will be used to monitor and measure the timeseries with the objective to set-up a n early warning detection sy	
80	T5.5 Development of a simulation model considering the supply chain operational risks previously defined, the blackouts occurrence and the market dynamics.	
81	T5.6 The systemic risk aspects of the interaction between the physical network and the commercial network on the electricity market will be analyzed.	
82	T5.7 Volatility analysis of the energy option markets and pricing of energy options in Europe.	
83	**Deliverables**	

ID	Name	Responsible
84	D5.1 Report on supply-chain logical model by means of the Petri nets formalism	
85	D5.2 Report on market dynamics model.	
86	D5.3 Report (paper) on Cross Recurrence Quantification Analysis between markets volatility and the dyanicsof power systems dynamic.	
87	D5.4 Report (paper) on coupled market dynamics and power systems chains.	
88	D5.5 Report on early warning detection algorithm and suggestions on how to implement it in real systems.	
89	**Milestones**	
90	M5.1 Supply-chain and market dynamics models ready and tested (M12)	
91	M5.2 Time series data provided (M12)	
92	M5.3 Coupled model ready and tested (M30)	
93	M5.4 Early warning detection prototype ready (M36)	
94	**WP6** Vulnerability of interconnected networks	**MASA**
95	**Tasks**	
96	T6.1 Apply spectral analysis of grid networks and graph erosion to detect the most vulnerable node and line elements of electricity and gas transport networks.	
97	T6.2 Compile macroscopic (at national level) of interdependency matrices for electricity and gas networks.	

ID	Name	Responsible
98	T6.3 Theoretical analysis of vulnerability of interconnected grids of differing topologies.	
99	T6.4 Analysis of the effect of scaling (number of nodes and lines) on the vulnerability for given grid topology types.	
100	T6.5 Verify or otherwise the scale invariance network topology of real European electricity and gas grids.	
101	T6.6 Vulnerability scenario analysis on the overall grid topology resulting from connection of large wind energy farms (data to be obtained from European Wind energy Association) onto present grid topology.	
102	T6.7 Develop fragility curves for electricity, gas and urban transport networks for man-made and natural threat scenarios. Case studies will be Finish grid system subjected to snow/ice storm. Gas network in E. Europe subjected to seismic and landslide, urban t	
103	**Deliverables**	
104	D6.1 A method to calculate interoperability matrices	
105	D6.2 Workshop on the deregulated European energy market	
106	D6.3 A report on a GIS-based method to assess fragility curves for interconnected systems.	
107	D6.4 A report on simulation of the dynamics (resilience and fragmentation) resulting from graph erosion of a realistic interconnected system	
108	**Milestones**	
109	M6.1 Network data available as per WP2 (up to M9)	
110	M6.2 GIS tool for interconnected systems set up by (M24)	

ID	Name	Responsible
111	M6.3 Availability of real-case electricity and urban networks of selected urban area (M20)	