ADEME
Agence de l'Environnement et de la Maîtrise de l'Energie

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Details and explanations

French solar heating and cooling development program based on energy performance (transient period)

TECSOL

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Intelligent Energy Europe

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www.tecsol.fr

Introduction

- **Wish of both French Government and Solar cooling professionnals to build a High Quality Solar Heating and Cooling Demo Projects Incentive Scheme**
- **Based on Selection criteria and public fundings (invest+monitor.)**
- **Highly supported by ENERPLAN (Solar Professionnal Association)**
- **An audit of existing solar cooling installations (20 in France since 1990) is ongoing**
- **Operational program starting in 2010 and for 2,5 years (June 2012)**

Program planning : (2009/2012)

Phase 1 : **PREPARATION** 12 months (jan.-dec 2009)

- **Reference elements & criteria definition**
- **Financial conditions definition**

Phase 2 : **ACTION** 30 months (jan. 2010 – june 2012)

- **Communication towards building owners & solar professionnals to find accurate projects**
- **Realisation of « success story » solar heating & cooling systems**
- **Monitoring and results checking & analysis**
- **Capitalisation of monitoring results and lessons learnt**
- **Dissemination & communication of the results**

Emergence program main principles

- **To implement conditions for projects financing:**

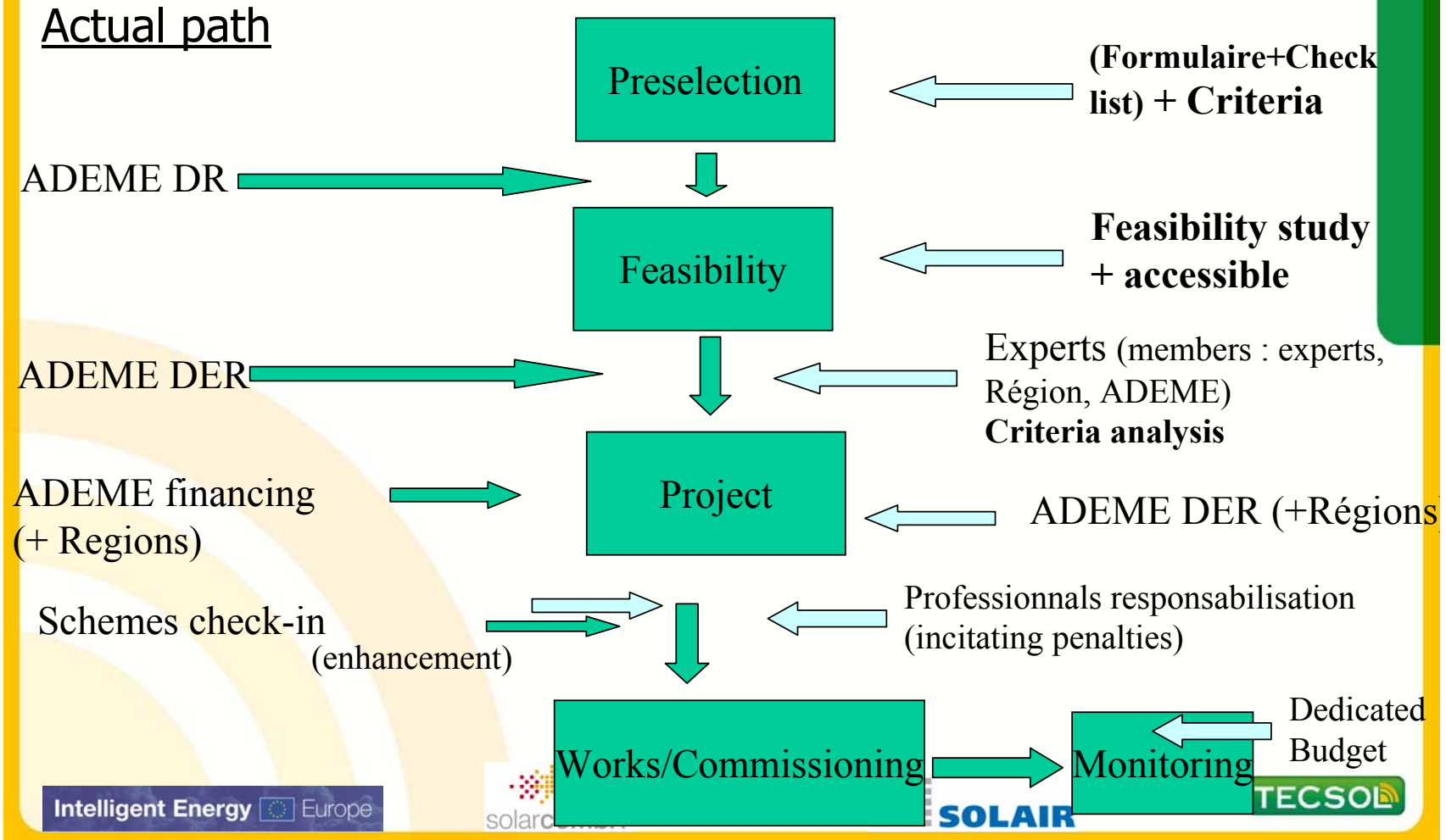
- **technically optimised (minimum solar yield & minimum COP_{elec} values)**
- **strongly implicating all the actors (building owners, planners, installers, O&M)**
- **leading to best practice cases in term of economical efficiency**

- **To make compulsory the monitoring by integrating it into financing mechanism (end of the grant delivered by m²)**

- **To get out from feedbacks some practical cases (building type, consortium type) where the investment/gain ratio is optimum**

- **3 to 6 installations are planned in the first year (2010)**

Principle


New path
Actual path
Preselection
(Formulaire+Check list) + Criteria
ADEME DR
Feasibility
Feasibility study + accessible
ADEME DER
Experts (members : experts, Région, ADEME)
Criteria analysis
ADEME financing (+ Regions)
Project
ADEME DER (+Régions)
Schemes check-in (enhancement)
Professionnals responsabilisation (incitating penalties)
Works/Commissioning
Monitoring
Dedicated Budget

Program application : 2 levels

- Projects selection and tools to do it..
- Performance criteria and incentive framework

Important notice :

All these Emergence program features are coming from a collective concertation between ENERPLAN (contact : Valérie Laplagne) , the Emergence working group (EDF, GDF, INES, TECSOL..) & ADEME, Direction des EnR (contact : Céline Coulaud)

Step 1 : efficient preselection tools (1/2)

Prefeasibility analysis step :

'Pre'-study divided into 2 parts :

1) Questionnaire giving technical infos (admin. elements,…)

2) Check list form. 20 questions on the features of the project (technical, economical and organisational).

Minimum score to reach

Output :

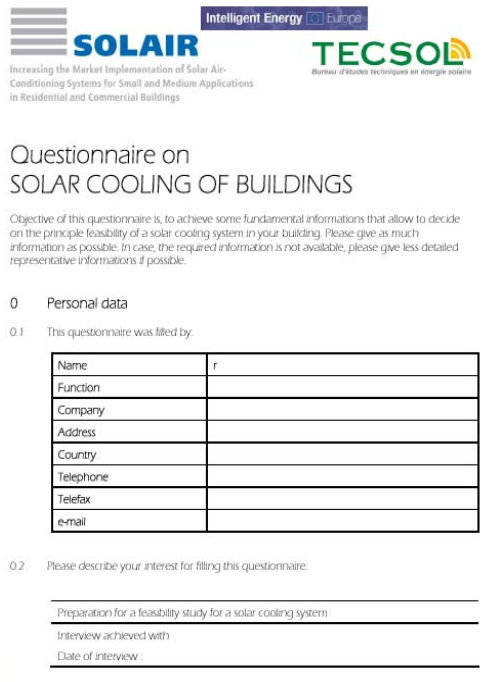
Financers (ADEME/ Région) are deciding to cofinance (or not) a feasibility study after the analysis of the 2 previous documents.

Step 1 : efficient preselection tools (2/2)

Prefeasibility analysis step:

- sensibilisation of regional info centers (ADEME, Régions, local energy agency)
- First level of expertise : online formular to fill in + check list
- Feasibility study financing or not
- SOLAIR example for the formular

  1. General infos
  2. Building technical installations
  3. Building load profile
  4. Building passive features (passive, active Energy concept)



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Increasing the Market Implementation of Solar Air-Conditioning Systems for Small and Medium Applications in Residential and Commercial Buildings

Questionnaire on
SOLAR COOLING OF BUILDINGS

Objective of this questionnaire is, to achieve some fundamental informations that allow to decide on the principle feasibility of a solar cooling system in your building. Please give as much information as possible. In case, the required information is not available, please give less detailed representative informations if possible.

0 Personal data

0.1 This questionnaire was filled by:

Name	r
Function	
Company	
Address	
Country	
Telephone	
Telefax	
e-mail	

0.2 Please describe your interest for filling this questionnaire:

Preparation for a feasibility study for a solar cooling system
Interview achieved with
Date of interview :

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CHECK-LIST « Solar heating&cooling »

CHECK LIST TYPE METHOD FOR THE SELECTION & SUCCESS OF SOLAR HEATING & COOLING INSTALLATIONS

Objectives: To make a fast diagnostic for a first rough evaluation of the accuracy for a solar heating & cooling installation.

Mean: Check-list to fill in by the client (building owner, planner) with multiple choice questionnaire. Example : available surface on the roof for the collectors large enough ? Thermal load (heating/cooling) in adequation with solar ressource ? Expensive avoided energy ?

Result: Automatic calculation achieved depending on the answers to nearly 20 questions and scoring method used to give a final score to the case.

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CHECK-LIST « Solar heating&cooling »

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Context: IEA Task 38 : international cooperation project
European & international collaboration (http://iea-shc-task38.org/)

Improvements since beginning 2009: more adapted questions, answer weighting method, warning messages (non realistic project)

Statistics:

« Excellent projects » (ISTAB, SOLACLIM):
16,4/20 average ; ecart type of 1
« Good projects » (Plein Sud Entreprises, RAFSOL, CARTIF, DREAM):
10/20 average ; ecart type of 1.5
« Sensible project » (example of an hotel in Nantes): score of 4/20

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CHECK-LIST « Solar heating&cooling »

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Classification / scoring

Score > 10: qualified project for a feasibility study

Score between 5 & 10 : project close to be qualified but requiring a deeper examination

Score between 0 & 5 : project close not to be qualified but requiring a deeper examination

Score with less than 0 : non qualified project

English version at the moment

Available tool on demand (romain@tecsol.fr)

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CHECK-LIST « Solar heating&cooling »

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Example of application of the Check-list.

CNRS/PROMES laboratory (Perpignan):

Laboratory inPerpignan, Mediterranean climate.
Sufficient roof area. Technical premices adapted
New distribution net. Existing back up installation.
Load correlated with solar energy ressource.
Average energy cost, average water cost
Important financial means and fundings (>50%).
Risk acceptation possible because demo project
Important environment politics
Qualified staff inside the lab.
Good monitoring of the installation (PhD in parallel).

Result: 16/20.

Example of application of the Check-list.

Hotel:

Small 4 levels hotel in Nantes, Oceanic climate.
Limited roof available area. Technical premices area compatible.
Existing adapted distribution net. Existing back up installation..
Thermal load partially adapted to solar energy (significant load during night).
Average energy cost, average water cost
Important financial means and fundings (20-50%).
No risk possible.
Wished environment action.
Non qualified staff for O&M, expensive external intervention.
Monitoring wished but no money to do it.

Result: 4/20.

Step 2 : study and final selection tool

Technico-economical feasibility study

- Answer to specification document of the program + calculation **proving** the maximum solar energy integration (mini performance criteria respect)
- Must lead to reasonnable sizings and solar coverage rate a priori not exceeding 50% (so as to respect minimum solar yield value).
- Financing rate of the study : to be defined with ADEME and depending on the concerned Regions. **Variable from 50 to 70%**. Maxi rate studied case by case
- The Engineering company in charge of the feasibility study needs to be responisble of the works engineering (if realisation) so as to assume the responsability of the design.

Reference minimum requirements for the engineering company selection : 2 references of large solar thermal installations of more than 30 m² + OPQIBI certification

Comparating presentation of the feasibility study contents...

Feasibility study content

PLAN EXISTANT d'ETUDE FAISABILITE Rafraichissement (ou climatisation)/ Chauffage Solaire

1. **Données du projet - Orientation de l'étude**
   - 1.1/ Présentation générale du projet
   - 1.2/ Equipements de climatisation, rafraîchissement/chauffage
   - 1.3/ Orientation de l'étude
2. **Description du bâtiment cible**
   - 2.1/ Structure du bâtiment
   - 2.2/ Occupation
   - 2.3/ Conclusions
3. **Impact de l'amélioration énergétique du bâtiment**
   - 3.1/ Modélisation du bâtiment dans les conditions initiales
   - 3.2/ Modélisation du bâtiment avec mesures passives (isolation de la toiture, ventilation nocturn
4. **Dimensionnement de l'installation**
   - 4.1/ Données du dimensionnement
   - 4.2/ Dimensionnement du groupe à absorption solaire
   - 4.3/ Capteurs solaires
   - 4.4/ Tour de refroidissement
   - 4.5/ Emplacement local technique
5. **Bilan thermique pour la production solaire**
   - 5.1/ Méthodes de calcul
   - 5.2/ Données météorologiques
   - 5.3/ Caractéristiques des composants
   - 5.4/ Présentation des résultats de calculs pour la production frigorifique solaire
   - 5.5/ Présentation des résultats de calculs pour la production calorifique solaire
6. **Principes d'installation et de fonctionnement**
   - 6.1/ Principe d'installation
   - 6.2/ Principes de fonctionnement
7. **Installation d'un système de télécontrôle**
   - 7.1/ Fonction du télécontrôle
   - 7.2/ Description des mesures
   - 7.3/ Suivi
8. **Bilan économique**
   - 8.1/ Evaluation du coût de l'opération
   - 8.2/ Evaluation du surcoût solaire
   - 8.3/ Evaluation de l'économie annuelle
   - 8.4/ Aides à l'investissement
9. **Impact sur l'environnement**

Annexes à joindre :
Annexe 1 - Schémas de l'installation
Annexe 2 - Calculs

OLD CONTENT

Proposition de nouveau PLAN ETUDE FAISABILITE Climatisation / Chauffage Solaire

1. **Données du projet - Orientation de l'étude**
   - 1.1/ Présentation générale du projet
   - 1.2/ Equipements existants de climatisation /chauffage
   - 1.3/ Orientation de l'étude
2. **Description du bâtiment cible**
   - 2.1/ Structure du bâtiment
   - 2.2/ Occupation
   - 2.3/ Conclusions
3. **Etude pour l'amélioration énergétique passive du bâtiment**
   - 3.1/ Charge thermique du bâtiment en conditions initiales
   - 3.2/ Propositions de mesures passives complémentaires (isolation de la toiture, ventilation nocturne, etc...)
   - 3.3/ Charge thermique du bâtiment avec mesures passives et impact financier

Bioclimatic features analysis

4. **Dimensionnement de l'installation**
   - 4.1/ Données du dim[illegible]
   - 4.2/ Dimensionnement du groupe frigorifique solaire
   - 4.3/ Capteurs solaires
   - 4.4/ Système de refroidissement
   - 4.5/ Emplacement local technique
5. **Bilan thermique pour la production solaire**
   - 5.1/ Méthodes de calcul
   - 5.2/ Données météorologiques
   - 5.3/ Caractéristiques des composants
   - 5.4/ Présentation des résultats de calculs pour la production frigorifique solaire
   - 5.5/ Présentation des résultats de calculs pour la production calorifique solaire
   - 5.6/ Calcul de l'intégration maximale de l'énergie solaire dans le profil de charge du bâtiment
6. **Principes d'installation et de fonctionnement**
   - 6.1/ Principe d'installation
   - 6.2/ Principes de fonctionnement

Mini performance proofs

7. **Installation d'un système de télécontrôle**
   - 7.1/ Fonction du télécontrôle
   - 7.2/ Description des mesures
   - 7.3/ Suivi de l'installation
8. **Bilan économique**
   - 8.1/ Evaluation du coût de l'opération
   - 8.2/ Evaluation du surcoût solaire
   - 8.3/ Evaluation des coûts d'entretien/maintenance
   - 8.4/ Evaluation de l'économie annuelle
   - 8.5/ Aides à l'investissement

Global cost concept

9. **Impact sur l'environnement**

Annexes à joindre :
Annexe 1 - Schémas de l'installation
Annexe 2 - Calculs

NEW CONTENT

Technical criteria

Technologies accepted *in priority* :

- **Open** to systems with sorption chillers **/** DEC

- **Products available on the market**

(French distributor present on the market with after sales structure + maintenance means).

- **Nominal solar cooling power range (system financed) : 5 to 200 kW**

- Reversible systems permitting to do Heating & Cooling (all year long valorisation)

- This power range permits to integrate the large majority of chiller manufacturers limiting the installation power thus their size

Technical criteria

Prioritary targets :

- Tertiary buildings
- Large dwellings
- Industry
- Agrofood

No geographical limitations on the projects (balance between heating and cooling changing between areas))

Objective : 15 to 30 financed installations on 3 years

(3 to 6 installations in 2010 – 5 à 10/year afterwards)

Technical criteria

Respect of 3 selection criteria : technology + performances

1 – Project data :

- targeted application (priority to the coupled use of solar heating & cooling energy)
- building type (prior energy optimisation)
- Place / climate
- Planned equipments must justify anterior experiences & feedbacks

Technical criteria

Respect of 3 criteria : technology + performances

2 - Minimum annual performance level to reach (controlled on monitoring)

- Minimum solar yield : **Estimated value in the feasibility study calculated from the useful solar thermal production for heating and for cooling with the following features :**

- **Heating : useful kWh out of the storage tank and without back up.**
- **Cooling : useful cooling kWh produced at evaporator divided by a ratio of 0,6 for absorption chillers and 0,4 on adsorption chillers (COP average value). Possibility to extend to double sorption chillers with value of 1.**

Thermal useful energy (all over in France) : **450 kWh/m².year**

- Notice : this kind of criteria will strongly favorise the schemes where the system is including a back up in serie like a reversible heat pump (solar precooling in Summer on a chilled water loop and solar preheating in winter on the heating loop) instead of a back up in parallel like a gas burner

Technical criteria

3 - Minimum electric annual efficiency :

- Calculated value of efficiency on a full year monitoring and equal to the ratio between useful solar energy kWh (thermal energy out of the solar tank in winter and out of the evaporator of the chiller in summer) and the overall yearly electric consumption of the auxillaries used in the solar system (except the distribution pump and the back ups).

- **Minimum electric overall efficiency of the system : 5**

(corresponding to an average yearly value for high efficiency actual heat pumps).

- Minimum value to reach in an average 2 full year monitoring campaigns (heating + cooling)

- Threshold value which could evoluate during the Program duration and permitting to increase the installation productivity & quality + enhancing the important benefit of valorising the solar cooling installation in heating mode.

Financial criteria

Budget frame for the program and grant calculation

35 000 €/TEP (≈ 0,15 €/kWh produced in 20 years operation)

Amount of incentive calculated on the total yearly useful energy planned in the feasibility study

+ Separated financing agreement for the monitoring including:

- Monitoring material at 100% financing
- Monitoring work (compulsory during the 2 first years) with *a minima* **3 energy measurments** (heating, cooling and parasitic electric) + inform the client if dysfunctionning **within 1 week**

Grant level :

- Monitoring material, **100%** covered limited to **10 000 €** (can do both control and monitoring)
- Monitoring work, **50%** for the 2 first years limited to **15 000 €**

Financing frame

Budget frame **:** European maxi grant levels / Renewable energy demo projects

- **60% on large groups**
- **70% on SME's**
- **80% on public structures and very small entreprises**

Remark : Grant calculated on global overcost on 5 years

= Investment surplus

– savings

+ operation&maintenance costs

Budget frame for the program and grant calculation :

Example : a real case commissionned in September 2009

190 500 €

Type of building : University building			
Place : Bordeaux			
Solar collector area	90	m²	
Nominal cooling capacity	35	kW	
Cooling production :	15 000	kWh	
Heating production :	20 000	kWh	
Heating production for cooling :	25 000	kWh	(=15 000/0,6)
TOTAL heating (useful heat) :	45 000	kWh	(=3,9 TEP)
Minimum useful heat production (450 kWh/m².y):	40 500	kWh	

Investment (w/o tax)	190 500	€
Investment per kW (w/o tax)	5 443	€
Investment per m² (w/o tax)	2 117	€

Final investment for the customer : **55 000 €**

Grant in €/TEP :	35 000	
Total grant amount for the project	135 426	€
Grant level (% on invest.)	71.1%	

Net payback time ≈ 11 years

Payback time without grants ≈ 43 years

Hypothesis :

- Avoided cold energy Gas heat pump (COP=1.5) : 0.05 €/kWh
- Avoided heat energy Gas heat network : 0.05 €/kWh
- O&M : 1% invest./year
- Amortisation :
  - Gas heat pump replacement (30 000€) on 10 years
  - Solar system replacement on 30 years

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Budget framework and funding rates
(inspired by « Fonds Chaleur » rules)

Investment grant (limited by European maximum rates) & repartition :

- **50% of total amount at contract signature and on presentation of the expenses justifications engaged (year 0)**
- **30% at commissioning** without reserves **(year 0 + 6 months)**
- Remaining 20 % under respect of the planned performances (COPelec + solar useful yield) **on the feasibility study and checked by the monitoring (year 0 + 2 year full monitoring).**

=> Building owner invited to make a contract with the consortium (Engineering + installer + O&M + Manuf. (collectors+chiller)) on this 20% => if the performances are not reached, the consortium has to pay back the building owner on this 20% basis.

Monitoring : staff made of 2 partners => engineering company + O&M company

General monitoring analysis/control by a third party (ADEME, subcontractor)

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Conclusions :

- **Emerging technology program starting running**
- **Presently Audit process launched among French solar cooling existing installations**
- **Very promising method to select performing demo installations**

For further details on this program project, refer to Daniel MUGNIER (daniel.mugnier@tecsol.fr)

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